WATER WORKS & SEWERAGE

L. H. ENSLOW, Editor

LEADING ARTICLES To Appear in the Next and Subsequent Issues:

An article by Jal. D. Edal Behram, Chemical Engineer, Bombay, India, describing the "Purification of Public Water Supplies in the Orient" is unusual; is interestingly written and illustrated.

John R. Baylis will present discussion on the "Evaluation of and Specification for Activated Carbons"—a timely topic on which more light is needed.

An article by Chas. P. Hoover, Consulting Chemical Engineer of Columbus, Ohio, will treat of methods of preventing corrosion by "Treatment of Circulating Water Used for Cooling Purposes in Industrial Plants." The author has devised a novel and effective method of attaining metal protection and increasing plant efficiencies materially hereby.

C. E. Keefer, Engineer in Charge of Sewage Treatment Works at Baltimore, Md., will present a description of a recently perfected "Continuous Automatic Sewage Sampler" which has been in successful use at the Baltimore plant and is also applicable to industrial waste control, such as that practiced in paper mills and other plants, to check the loss of valuable manufacturing material through the sewer.

Water Softening is becoming an increasingly important phase of water treatment and Donald H. Maxwell, Consulting Engineer of Chicago, describes the recently completed "Water Softening Plant at Western Springs, Ill."

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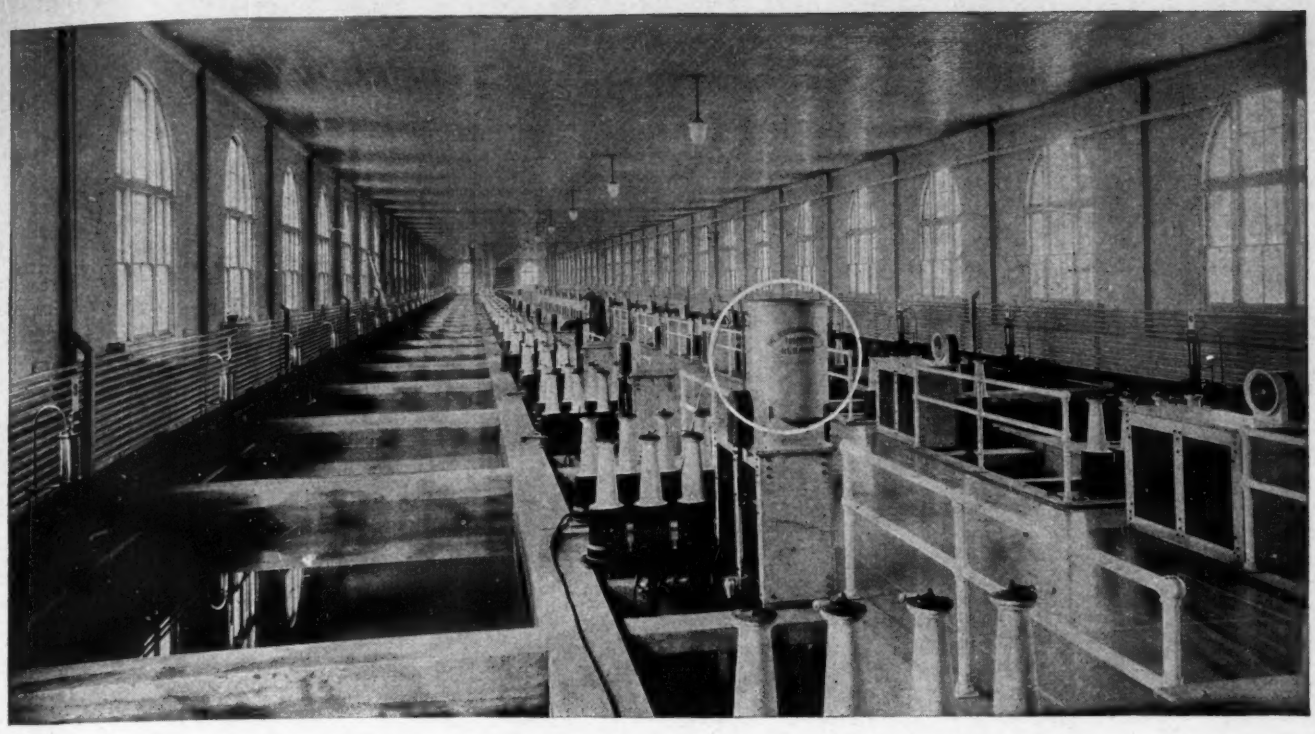

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A PROPHET *not* WITHOUT HONOR!

How Geo. R. Spalding conceived the idea that potable waters could be made more universally palatable. . . and proved it to be right.

GEO. R. SPALDING, Sanitary Engineer, Hackensack Water Company, New Milford, New Jersey

FOLLOWING OUT his policy of keeping posted on what was being done in fields other than water purification, Spalding noted the widening use of activated carbon in the refining of edible oils and fats, glycerine, pharmaceutical and medicinal products.

He reasoned that if activated carbon would serve to remove odors, colors and colloidal substances in those fields, it would also remove the causes of tastes and odors in potable waters.

Spalding foresaw that this insoluble material, if it worked, would offer the advantage of contributing no tastes and odors of its own and, when its work was done, would not have to be passed along to the water consumer.

He expressed the opinion that powdered activated carbon should (1) be finely powdered, (2) be completely distributed through the water by effective mixing, and (3) have a sufficient period of contact to permit proper adsorption.

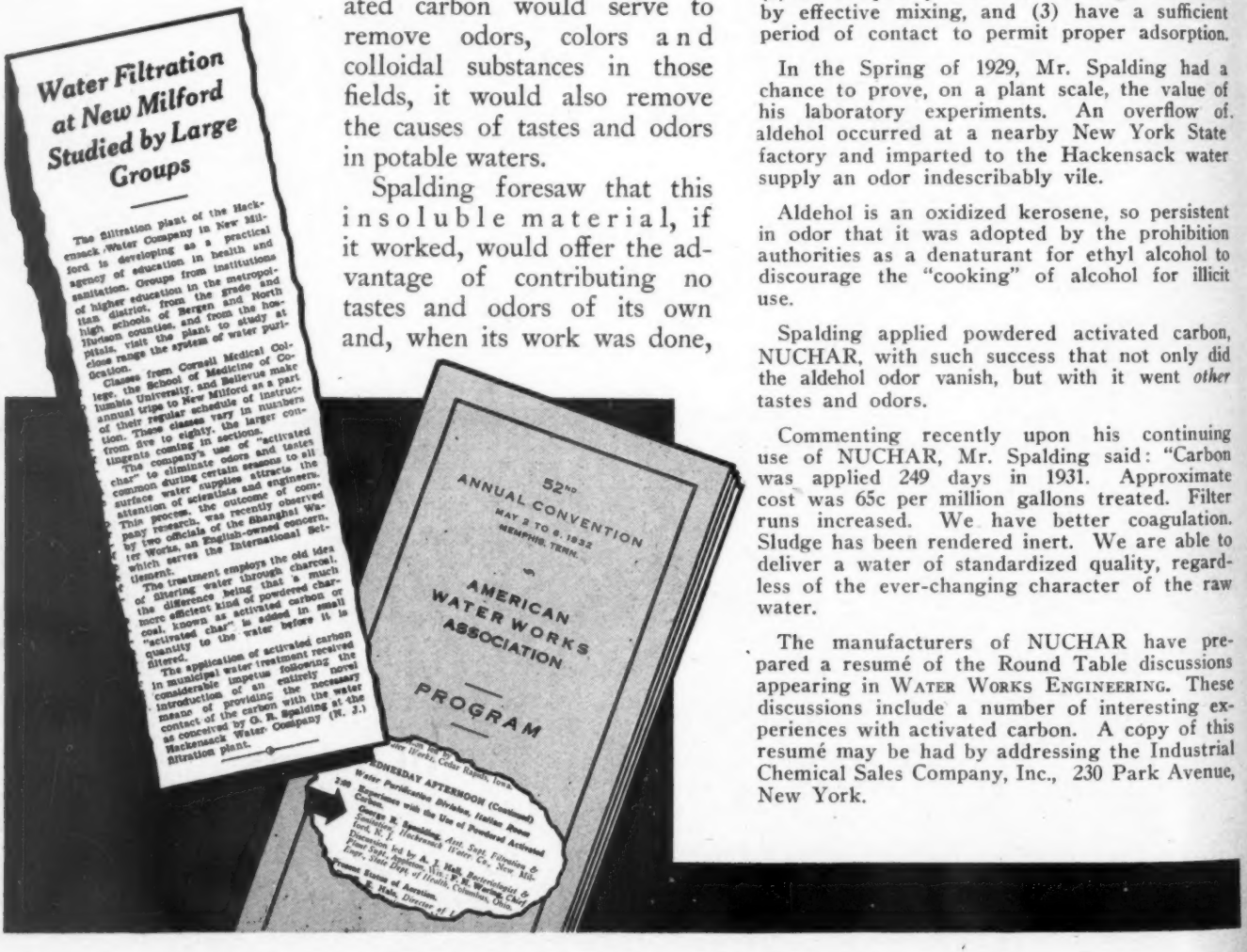
In the Spring of 1929, Mr. Spalding had a chance to prove, on a plant scale, the value of his laboratory experiments. An overflow of aldehol occurred at a nearby New York State factory and imparted to the Hackensack water supply an odor indescribably vile.

Aldehol is an oxidized kerosene, so persistent in odor that it was adopted by the prohibition authorities as a denaturant for ethyl alcohol to discourage the "cooking" of alcohol for illicit use.

Spalding applied powdered activated carbon, NUCHAR, with such success that not only did the aldehol odor vanish, but with it went *other* tastes and odors.

Commenting recently upon his continuing use of NUCHAR, Mr. Spalding said: "Carbon was applied 249 days in 1931. Approximate cost was 65c per million gallons treated. Filter runs increased. We have better coagulation. Sludge has been rendered inert. We are able to deliver a water of standardized quality, regardless of the ever-changing character of the raw water.

The manufacturers of NUCHAR have prepared a resumé of the Round Table discussions appearing in WATER WORKS ENGINEERING. These discussions include a number of interesting experiences with activated carbon. A copy of this resumé may be had by addressing the Industrial Chemical Sales Company, Inc., 230 Park Avenue, New York.


Water Filtration at New Milford Studied by Large Groups
The filtration plant of the Hackensack Water Company in New Milford is developing as a practical agency of education in health and sanitation. Groups from institutions of higher education in the metropolitan district, from the grade and high schools of Bergen and North Hudson counties, and from the hospitals, visit the plant to study at close range the system of water purification.
Classes from Cornell Medical College, the School of Medicine of Columbia University, and Bellevue make annual trips to New Milford as a part of their regular schedule of instruction. These classes vary in numbers from five to eighty, the larger contingents coming in sections.
The company's use of "activated char" to eliminate odors and tastes common during certain seasons to all surface water supplies attracts the attention of scientists and engineers. This process, the outcome of company research, was recently observed by two officials of the Shanghai Water Works, an English-owned concern, which serves the International Settlement.
The treatment employs the old idea of filtering water through charcoal, the difference being that a much more efficient kind of powdered charcoal, known as activated carbon or "activated char" is added in small quantity to the water before it is filtered.
The application of activated carbon in municipal water treatment received considerable impetus following the introduction of an entirely novel means of providing the necessary contact of the carbon with the water as conceived by G. R. Spalding at the Hackensack Water Company (N. J.) filtration plant.
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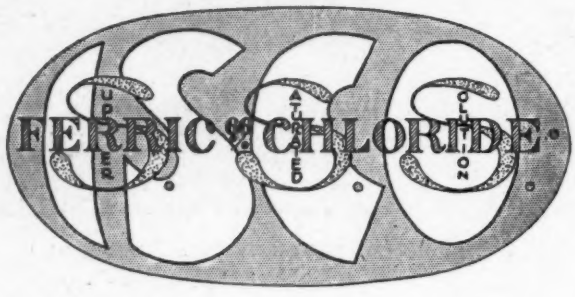

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WATER WORKS AND SEWERAGE

VOL. 79 No 8 AUG. 1932

A GILLETTE PUBLICATION

TRACING THE TRAVEL AND CHANGES IN COMPOSITION OF UNDERGROUND POLLUTION

By ANSELMO F. DAPPERT

Principal Sanitary Engineer,
N. Y. State Department of Health

A. F. Dappert

ROCKVILLE CENTRE, on the south shore of Long Island, has a population of 12,000. It employs the activated sludge process of sewage treatment. Final disposal of the sewage plant effluent is accomplished by discharge onto 5 acres of natural sand beds through which the effluent seeps and enters the ground water. The sewage flow averages about 1.2 m.g.d.

The exact effect of the discharge of such a large quantity of sewage effluent into the ground water in the manner outlined has been a matter of peculiar interest to neighboring residents for a considerable time. Property owners adjoining the plant have registered complaints alleging dangerous contamination of private wells and material increases in the infiltration of ground water into basements. Recently an opportunity was given for a detailed study of the extent to which pollution traveled in the underground seepage from the percolation beds and the progressive changes in quality effected during such travel.

Three property owners living along Parsonage Creek, a small stream that rises about one-fourth mile south of and below the percolation beds and which is fed to a large extent by springs, recently entered an action in the Supreme Court of Nassau County against the village of Rockville Centre, charging pollution of Parsonage Creek. The action presumably was started as a result of the occasional operation of an illegal by-pass which permitted discharge of final tank effluent direct to the creek. The allegation in the complaint as filed, however, went considerably further and charged *"That the filter beds are constructed and maintained in such manner that waters therefrom seep into and enter the head waters of the said Parsonage Creek, carrying with them harmful bacteria and other matters and substances which contaminate and pollute the waters of said Parsonage Creek, rendering them unfit for use and dangerous to the health of the plaintiffs and other residents along the course of said Parsonage Creek."*

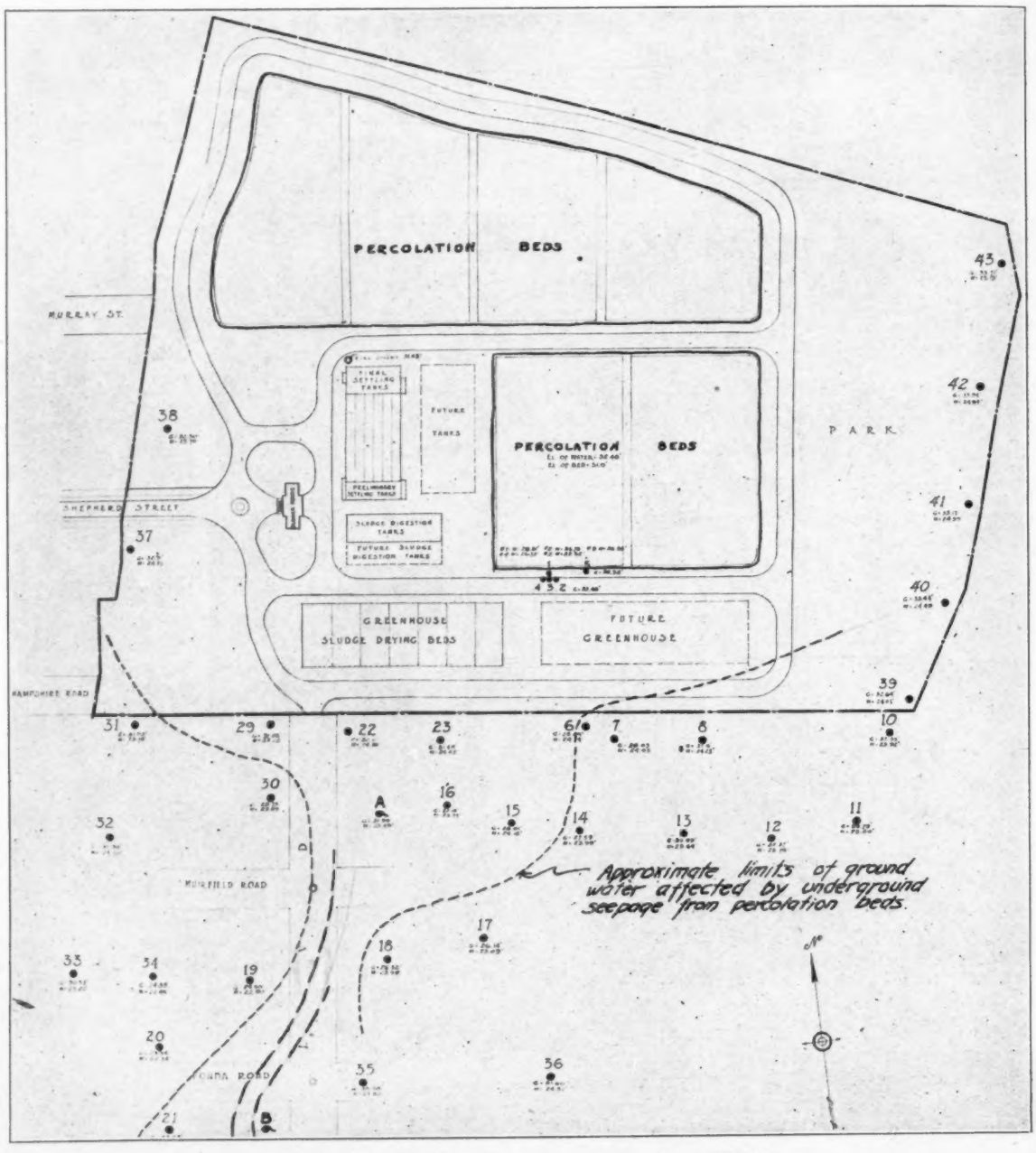
In view of the seriousness of this charge the State Department of Health conducted a detailed study of the matter during the period of April 18 to 23, 1932.

The accompanying sketch indicates approximately the location of the sewage treatment plant with respect to Parsonage Creek.

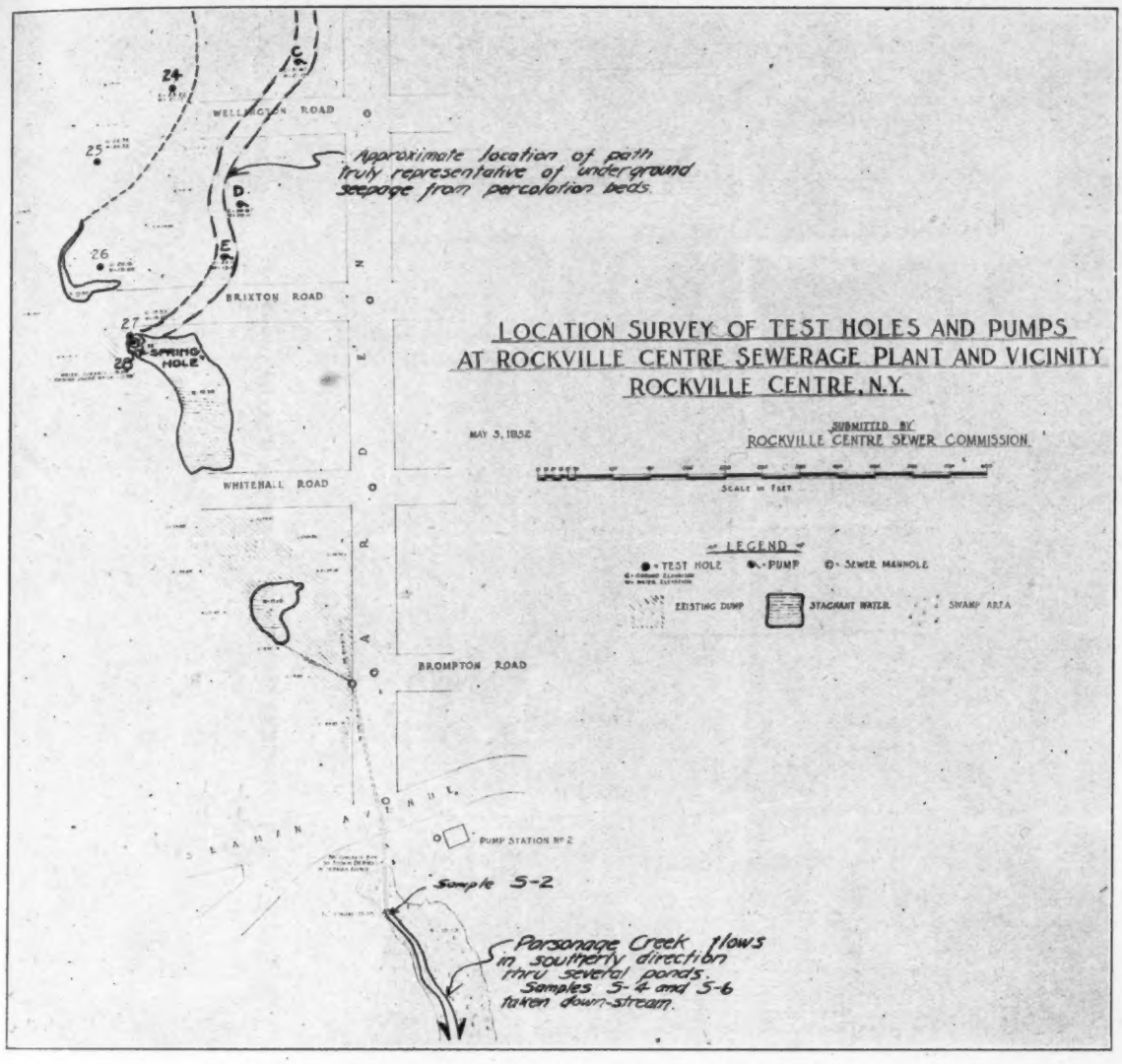
Normally a sewage effluent produced by the activated sludge process under proper operating conditions is in general terms, practically clear, stable, non-putrescible, relatively free of suspended material, low in bio-chemical oxygen demand, and with a changed and reduced bacterial content, so that it may be safely applied to percolation beds or discharged to natural waters without the creation of offensive conditions. Further, it is a well known fact that polluted waters in traveling a comparatively short distance through sandy soils become purified by reason of the natural purification process established in the soil. In the case of Rockville Centre

then, it could reasonably be expected that whatever bacteria are contained in the effluent as applied to the percolation beds would be completely removed in the first 200 to 300 feet of travel of the seepage through the soil and that any organic matter contained in the effluent would eventually become completely oxidized. On general principles, then, it would seem that harmful pollution or contamination of creek waters could not result from the method of sewage disposal employed by the village.

To secure definite information bearing upon this question numerous borings were made to the ground water in the vicinity of the plant and between the percolation beds and headwaters of the creek. In all, 42 such borings were made at the locations shown on the accompanying map. These borings were made with a hand auger to a maximum depth of about 10 ft. which was sufficient in most cases to reach ground water. Samples were then collected from the various bore holes and tested for chlorides. Chlorides, being harmless, inert mineral constituents of sewage undergo no appreciable change during the process of sewage treatment and the chloride value of the sewage effluent could therefore be expected to remain fairly constant within reasonable limits—i. e., about the same as in the raw sewage. Chlorides could be expected to be high in sewage or sewage effluents and low in normal surface or superficial ground waters. The chloride test therefore afforded a definite means of locating with certainty the underground path of seepage from the percolation beds. Employing the chloride determination on surplus for the test holes, the path of underground seepage was definitely located at several points and driven wells were put down to permit the collection of samples for systematic bacteriological and chemical analyses. Although the limits of the band of seepage could not be definitely determined throughout the 1,500 ft. length of the path between the percolation beds and the creek, due to an inadequate number of bore holes, sufficient data were obtained from the chloride tests to indicate that the approximate dimensions of



Sketch Showing Layout of Sewage Treatment Plant



Location Survey of Test Holes and Pumps

such band of seepage are as shown on the accompanying map. The tests for chlorides indicated that the band of seepage from the percolation beds narrowed rapidly at points near the percolation beds and that the underground flow from the south line of the plant property to the "spring-hole" conceded to be the headwaters of Parsonage Creek, was through a narrow band scarcely more than 50 ft. wide at point midway between the plant and creek. The results further show, that this narrow band was not on a straight line but was somewhat irregular. Driven Wells A, B, C, D, and E were placed on a straight line between the "spring-hole" and Percolation Bed No. 6 and samples gave the following chloride results in parts per million:

Sample	Chlorides p. p. m.
Effluent taken from bed	38.0
Well A	14.6
Well B	21.3
Well C	32.5
Well D	20.3
Well E	33.0
Spring hole	33.0
Bore hole 24 (not influenced by seepage)	3.4

It will be noted that while samples from all the wells showed the influence of percolation bed seepage, that only wells C and E could be considered, making allowances for slight fluctuation in the chloride content of the sewage effluent, as truly representative of the underground path of seepage from the percolation beds. Even in the case of samples from Wells C and E the indications are that the samples were to a very slight extent diluted with normal ground water, as might reasonably be expected.

Bacteriological Changes During Progress of Seepage

The results of the chemical and bacteriological examination upon samples collected from the percolation beds from driven wells C and E which represent the underground seepage from the percolation beds after passage through 1,000 and 1,400 ft. of fine sand respectively; from the "spring-hole" which represents seepage from the percolation beds immediately after springing to the surface and after traveling 1,500 ft. through the soil; from the upper end of Parsonage Creek proper; from the outlet of Selley pond; and from Parsonage Creek below all ponds, are of interest in tracing pollution originating at the percolation beds during its passage through the soil and later through an open watercourse. These results are tabulated on Table I. Samples for bacteriological analysis were taken from Wells A, B, and D, which penetrated ground waters influenced in varying degrees by seepage from the percolation beds and the results showed uniformly very low bacterial counts and

TABLE I—RESULTS OF ANALYSES

(Results expressed in parts per million unless otherwise stated)

Index Number or Letter...	X	C	E	28	S-2	S-4	S-6
Description of Sample.....	Sewage Effluent from Percolation Bed	Sample from Well Penetrating Path of Seepage from Beds	Sample from Well Penetrating Path of Seepage from Beds	Sample from "Spring-Hole" Representative of Seepage from Beds After Springing to Surface	Surface Sample from Upper End of Parsonage Cr.	Surface Sample from Outlet of Seeley Pond	Surface Sample from Parsonage Cr. Below All Ponds
Approximate distance below plant along line of flow..	0	1,000 ft.	1,400 ft.	1,500 ft.	2,300 ft.	3,900 ft.	5,700 ft.
Color	21	2	1	10	10	7	7
Turbidity	30	1	1	15	12	5	5
Nitrogen							
*Ammonia Fr.	12.5	5.5	6.0	3.0	3.8	0.7	0.14
Ammonia Alb.	0.154	0.550	0.040	0.124	0.108	0.12	0.226
Nitrites	0.020	0.040	0.040	0.012	0.020	0.028	0.016
*Nitrates	0.04	8.8	10.0	0.50	0.90	1.12	2.1
*Organic total	7.14	2.8	1.39	0.74	1.34	0.30	0.94
Oxygen consum.	10.0	2.1	1.8	5.1	3.8	3.0	4.9
Chlorides	38.0	32.5	33.0	33.0	28.0	16.4	15.2
Bacteria							
Per cc. 20° C.....	liquified	1	0	4,500	1,300	1,700	3,400
Per cc. 37° C.....	10,000	2	1	85	900	370	260
Test for B. Coli Group							
In 10 cc.....	3+0—	0+3—	0+3—	3+0—	0+3—	3+0—	3+0—
In 1 cc.....	3+0—	0+3—	0+3—	0+3—	0+3—	1+2—	3+0—
In 1/10 cc.....	3+0—	0+3—	0+3—	0+3—	0+3—	0+3—	0+3—
In 1/100 cc.....	3+0—	0+3—	0+3—	0+3—	0+3—	0+3—	0+3—
In 1/1000 cc.....	3+0—	.....	.....	.....	.....	.....	.....

*Note the rapid and marked reduction of organic nitrogen and conversion of ammonia to nitrate during travel of the effluent underground and away from contact with air. This observation is the more interesting when it is recalled that in slow sand filtration of sewage effluents the beds must be allowed to "breathe" between applications—something which could not take place in the underground "sand beds" at Rockville Center.—Editor.

the absence of organisms of the B. Coli group in all volumes tested.

Since the results of the bacteriological examination show in the case of each sample taken from the wells penetrating the path of seepage from the beds, the complete absence of organisms of the B. coli group, it must be concluded that possible harmful bacterial contamination present in the effluent as applied to the percolation beds is removed in a comparatively short distance of travel of the seepage through the soil. That this distance is less than 400 ft. is indicated by the fact that a sample from Well A situated 400 ft. from the percolation beds gave negative results in the tests for B. coli. The bacteriological results, therefore, indicate that harmful bacterial contamination of creek water is not contributed by seepage from the percolation beds as alleged by the complaint as filed. The bacteriological contamination indicated in the sample from the "spring-hole" and in the samples collected from Parsonage Creek can reasonably be explained by the exposed nature of the water and local surroundings—matters unrelated to the sewage disposal works.

Rockville Center Sewage Treatment Works. Blowers and Laboratory in Building on Right

Seepage Beds with Treatment Plant in Rear. (Note Sludge Gas Holder and Glass Covered Sludge Beds to Left. Blower House in Center)

Chemical Changes During Progress of Seepage

The chemical examinations of the various samples show some interesting and possibly some surprising results.

It will be noted, as reflected by the analysis, that the sewage effluent in moderately colored and turbid, relatively high in free ammonia and low in nitrates. As regards nitrogen quite the reverse was expected since normally the effluents from activated sludge plants are rather highly nitrified. While the value for total organic nitrogen and oxygen consumed were a little higher than anticipated they are not abnormally high and no difficulty is experienced with respect to odors emanating from the percolation beds. The effluent, despite its fairly high organic content, is sufficiently stable for disposal upon open percolation beds without creating objectionable odors. Difficulty has been experienced, however, with sludge bulking at this plant and even under normal operating conditions moderate quantities of floc are carried continuously in the effluent as applied to the perco-

lation beds. The results for turbidity, free ammonia, total organic nitrogen and oxygen consumed are therefore probably influenced considerably by the presence of such floc which is readily filtered out by the sand in the percolation beds.

After traveling 1,000 and 1,400 ft. underground through the fine sand, characteristic of the region, the effluent changes appreciably in its chemical makeup as indicated by the analyses of samples C and E. Variation in the results for these two samples can be logically explained by variation in the chemical quality of the sewage effluent as applied to the beds. Compared with the sewage effluent on the percolation beds samples from both C and E show about 50 per cent reduction in free ammonia and a striking increase in nitrates.

Further changes are indicated by the results as the seepage from the percolation beds springs to the surface and becomes mixed with the exposed water in the "spring-hole." Free ammonia decreased appreciably and there is a striking decrease in nitrates. The bed of this pond was covered with a jelly like growth suggestive of iron bacteria and this fact may account for the abrupt decrease in nitrate content. That the water in the

One of the Driven Wells Installed for Purpose of Obtaining Samples from Underground Path of Seepage from Percolation Beds

"spring-hole" is former sewage effluent is indicated by the chloride value.

The results for the three samples from the surface stream show a progressive decrease in free ammonia content with a corresponding increase in nitrates indicating that the organic matter is gradually becoming oxidized. The results further show some increase in organic pollution when compared with the results on the samples from the underground path of seepage. That the water in the lower reaches of the stream is about 50 per cent made up of seepage from the percolation beds is indicated by the chloride values on samples S-4 and S-6.

As a result of the study the conclusion was reached that seepage from the percolation beds does reach Parsonage Creek carrying with it certain chemical ingredients which otherwise would not be present in abnormal quantities in the natural surface water—i. e,. chlorides and nitrogen as free ammonia. However, that such contamination is dangerous to health was denied.

The significant feature of the results is the fact that chemical pollution as represented by free ammonia was demonstrated to have been carried 1,500 ft. through the fine sand of the region. The fact that the effluent upon springing to the surface at the "spring-hole" carried 3 parts per million free ammonia compared to 12.5 originally present in the effluent as applied to the percolation beds suggests that a considerable additional distance of travel through the soil would have been necessary to reduce the value to a normal for unpolluted ground water of the region.

In the particular case in question, nitrogen in the creek water either as free ammonia or nitrates may become a basis for objection because of the algae growth which it probably stimulates in the ponds through which Parsonage Creek flows.

Sewage Treatment Program Of Sanitary District of Chicago

In the semi-annual report of January 1, 1932, the status of the sewage treatment construction program involved in this case was stated to be on December 1, 1931, as follows:

Completed Work as of December 1, 1931	
Calumet Project	$20,764,788.56
North Side Project	36,881,252.58
West Side Project (including Des Plaines)	41,272,214.50
Southwest Side Project	271,291.57
Miscellaneous Plants and Sewers	595,978.63
Chicago River Controlling Works	53,415.74
Total	$99,838,941.58

Future Work After Dec. 1, 1931	
Calumet Project	$ 18,885,133.46
North Side Project	4,973,258.85
West Side Project (including Des Plaines)	61,461,039.82
Southwest Side Project	70,545,708.43
Miscellaneous Plants and Sewers	9,906,619.43
Chicago River Controlling Works	3,946,584.26
Total	$169,718,344.25

During the interim of six months between the date of the last report and the present report, very little construction has been accomplished.

Water Works Construction Behind Schedule

The Cast Iron Pipe Research Association is now far enough along in their water works construction survey to be able to give you some interesting data.

Of the 3,165 towns and cities having a population of 2,500 and over, they have thus far analyzed reports secured from personal calls on city officials of 1,769 towns or approximately 56 per cent of the total number.

These towns divide as follows:

	Number	Per cent
Class I No money—no improvements needed	346	19.5
Class II No money—need improvements	232	13.1
Class III Have no money — no improvements needed	440	24.9
Class IV Have money—need improvements	543	30.7
Class V Private water companies	208	11.8
	1,769	100.0

The Association feels that the number of towns thus far called upon represent more than an adequate sample on which to predicate an assumption that the final percentages will be approximately as above. It will be noted that 43.8 per cent of the towns included in the above table are municipally owned properties that need waterworks improvements. If we add to this the needs of private companies, it will be seen that well over 50 per cent of all communities, having populations greater than 2,500, are behind in waterworks construction.

In addition to waterworks improvements, a number of towns have mentioned that they contemplate the construction of sewage disposal plants.

"Old Main" Central Building, Pennsylvania State College, in which Sessions of Conference Were Held.

PENNSYLVANIA WATER WORKS OPERATORS' ASSOCIATION

THE fifth annual conference of the Pennsylvania Water Works Operators' Association was held on June 20, 21 and 22 at the Pennsylvania State College at State College, Pennsylvania, with a total registration just short of 200, being but slightly under that for the 1931 meeting. The members and guests were again housed in the college dormitories.

Unusual features of the program included the "Trouble Hour" during which the operators of fourteen plants in Pennsylvania presented in their papers kinks and troubles in the operation of their various plants.

At the banquet on the evening of June 21, with approximately 180 present, the usual "round table" discussion or "question box" was omitted unfortunately and the evening was devoted entirely to entertainment. Door prizes were presented, including special ones which contributed much to the merriment of the occasion. Harry Freeburn, of the Pennsylvania State Department of Health, acted as Toastmaster and H. L. Nelson of the U. S. Pipe and Foundry Company, pulled a few stunts of magic, using the powerful words "activated clays" and "bleaching carbons."

Another special feature of the convention was the issuance of "The Effluent," a paper which appeared daily during the course of the convention. M. E. Flentje, Purification Engineer of the Community Water Service Company, served as its editor and "Mike" Glace as business manager. The "Ballyho" style advertising section included with the first day's issue was particularly amusing.

At the business meeting of the association considerable discussion was given to the consolidation of the Pennsylvania Water Works Operators' Association with the Pennsylvania Sewage Works Association. A tentative constitution for the combined association, to be called The Pennsylvania Water Works and Sewerage Association, was presented for consideration. It was the opinion that the matter should be referred to the executive committee of the association for conference with the executive committee of the Sewage Works Association before presensation for a vote at the next annual meeting. Like action was taken by the Sewage Works Association — which met later in the week.*

George R. Taylor, Chemist, Scranton Spring Brook Water Co., Retiring President.

Another important matter discussed at the meeting was the question of licensing operators. The President of the Association was authorized to appoint a committee to study the matter for report at next year's meeting.

Conference members voted to charge a registration fee of $1.00 for members and $2.00 for non-members at future meetings. To date there has been no charge for registration.

Resolutions were adopted at the meeting thanking the College authorities for their interest, cooperation and assistance in the handling of the convention. The members of the association likewise voted, practically unanimously, to hold all future meetings at State College which has the unusual advantages of central location, beautiful topography and climate, and fine facilities for lodging members and guests at low cost in the new college dormitories, not to mention the college golf course which is near at hand and considerably used during the meetings at State College.

A resolution was passed lamenting the death of two members—F. T. Lamy and G. S. Allen.

Officers elected for the ensuing year are the following:

President—E. C. Trax, Superintendent of Filtration, McKeesport, Pa.

First Vice President—M. E. Flentje, Superintendent of Purification, Community Water Service Co., Greensburg, Pa.

Second Vice President—H. B. Richards, Superintendent, New Castle Water Co., New Castle, Pa.

Secretary-Treasurer—I. M. Glace, District Engineer, Pennsylvania Department of Health, Harrisburg, Pa.

Papers and Discussions

A paper which was presented in rather too technical style to be best comprehended but one which created considerable interest and discussion was that read by **Dr. E. M. Slocum** of the General Reduction Company, Macon, Ga., which treated of the **Action of Absorbent Clays in Water Systems.** Dr. Slocum's paper was followed by a discussion by **R. I. Dodd,** reciting the experiences at Chester, Pa., with absorbent clay application on plant scale practice for removing oily taste and odors from the water. The use of the clay to the extent of 5.1 parts per million applied to the highly polluted Delaware River water ahead of the coagulant had resulted in better color removal and coagulation. It had successfully removed a taste estimated as 5 oily, but had not removed a vegetable odor and taste. The clay had not reduced the chlorine demand of the water but with its use ammoniation could be discontinued without difficulty.

Dr. Slocum pointed out the power of absorbent

*Report of the meeting of the Sewage Works Association appears elsewhere in this same issue.—Ed.

clays—so-called bleaching clays—to absorb chlorine from the water and increase the pH value; to absorb color and increase clarification by increased gravity of the floc produced by the coagulant. He thought the clays particularly effective as absorbents of phenols and oily compounds but that odors would perhaps be more effectively removed by chlorine and activated carbon. The bleaching clays were procurable at ¾ cents per pound delivered at Pennsylvania points.

E. L. Luaces of the Industrial Chemical Sales Company, in discussion pointed out some of the major differences between absorbent clays and activated carbon and thought perhaps in some instances a combination of the two might be most effective.

Another paper creating considerable interest was that of **Professor L. V. Carpenter,** of the University of West Virginia in which observation of the **"Sterilizing Effect of Acid Mine Waters"** were reported. Professor Carpenter said that experiments had shown that acid mine waters (8000 p.p.m. acidity to methyl red and having a pH value of 2.) when added in the ratio of 1 part to 9 parts of sewage had resulted in complete b.coli destruction after 3 hours. With 5 per cent mine water added the destruction had been 95 per cent complete after but one hour. In the practical treatment of mine water for preventing stream pollution by it, Profession Carpenter said that he felt that neutralization with chemicals would always be impractical. Inasmuch as the production of the acid was in part, at least, due to biological phenomena he thought that a splitting of SO_4 ion and utilization of the sulphur by some organism might prove to be the answer.

Geological Formations and Water Supply

Dr. George H. Ashley, State Geologist of Harrisburg, Pa., presented an intensely interesting lecture on the topic of **"Water Bearing Strata,"** first having discussed the topic in general. He then cited Pennsylvania circumstances and localities to which his remarks applied concerning the likelihood of striking water in deep well drilling and the expected quality and quantities to be found. He pointed out the fact that in formations where the bed rock lay flat the water was apt to be highly mineralized whereas from inclined formation it would not generally be so. The poorest formations for yielding ground water of any consequence were those in the Southeast part of Pennsylvania. He said that his Bureau had done a considerable amount of advising in connecitons with well drilling operations and that a new Geological map of Pennsylvania prepared by the Bureau would shortly be available from the Bureau of Publications.

Dr. Ashley having given such an interesting talk had many questions put to him from the floor and explained the source and reason for the large springs in the central part of the state, the past history of certain water courses and regional geological structure. He also explained the acidification of mine water as principally a matter of chemical oxidation of sulphides of iron in contact with atmospheric oxygen and moisture. As a result there was a production of ferrous sulphate (Copperas) which of course hydrolyzed to produce sulphuric acid and hydroxides of iron eventually precipitated in the streams.

Mr. F. H. Snow, extended compliments on the work and researches carried forward under Dr. Ashley's guidance.

"Filter Sands and Gravels" was the subject of a talk by **R. F. Abel** of the Menantico Sand and Gravel Company at Millville, N. J., in which moving pictures were employed to illustrate the mining, handling, preparation and grading of sand and gravel for use in filters. The grading of the sand is finally accomplished by hydraulic means, an upward flow washing away the "fines" and jig-screens removing the coarse fractions. Six hydraulic sand grading cones are connected in series. The screens employed are of the vibrating (Hummer) type. Sand and gravel is transported from the mine pit through the plant to the bins by centrifugal pumping of slurry at a consistency of 10% solids and the plant has a capacity production of 4 tons of filter sand per hour. Only 15 per cent of the sand mined being recovered as satisfactory filter sand. The methods of testing for control and to insure meeting final specifications were described—no less than 30 tests being made during the loading of a single car of sand which had to be 99.3 silica or better. Mr. Abel discussed the value of sharp grained sand as contrasted with rounded grain sea sands in water filters.

"Water for Industrial Purposes"—by **A. S. Behrman,** Chemical Director, International Filter Company, Chicago, Ill.

A. S. Behrman, Chemical Director, International Filter Co., Chicago.

E. C. Trax, Superintendent Filtration McKeesport, Pa., President-Elect, 1932-33.

Mr. Behrman said that there were practical limitations to the extent of treatment of water to which a municipality could justly go. Beyond that point any further treatment should be given by the industry needing a better product than had proven satisfactory for domestic supply. He said that the ordinary lime-soda softening was usually the most that a municipality should do in the way of softening. Anything beyond that, such as could be secured through base exchange softeners was the industries' problem and should be effected by them.

Manufacture of raw-water ice had about displaced the use of distilled water and a satisfactory water for ice could be produced from lime treatment alone. Removal of iron and most of the temporary hardness was all that was demanded by ice-makers. The residual normal carbonates in the lime treated water could be neutralized by adding sufficient sulphuric acid to leave about 10 parts of total alkalinity with good effect in ice production. Zeolite softening was absolutely wrong in ice manufacture because the process left too high concentration of dissolved salts in the water.

In textile mills, laundries and dyeing plants, the principal requirement was a water of very nearly zero hardness and therefore base exchange (Zeolitic)

R. C. Wheeler, Consulting Engineer, Albany, N. Y.

Harry Krum, Superintendent Water and Sewage Plants, Allentown, Pa.

softening was highly desirable and particularly so since no caustic alkalinity could be tolerated in the water used. It would be highly impractical for a municipality to produce such a product, one reason being the corrosiveness of a Zeolite softened water which carried none of the protective calcium salts for coating the pipes.

For bottling works and food products production the essential requirement is a water free of taste and odor. For bottling beverages iron could not be tolerated because of precipitation which ensues. Water of low pH value is desirable because there is a relationship between pH value and taste. In such establishments the use of pressure filters filled with activated carbon has proven very satisfactory. In some instances super chlorination ahead of the carbon units is practiced.

To produce boiler feed water of the most satisfactory sort the solids content of the softened water should be at a minimum to preclude foaming. The hot lime-soda process was usually the most satisfactory means of preparing boiler water. Residual sodium salts were not desirable in boiler operation and the addition of sulphuric acid or sulphate of soda was practiced to maintain a definite ratio of carbonate (CO_3) to sulphate (SO_4) ions to prevent embrittlement and allied troubles. Corrosion was prevented best by carrying a high pH value and removal of dissolved oxygen from the feed water.

In reply to a question, Mr. Behrman thought that municipal softening should not be carried beyond that required to produce a water of between 68 and 85 parts per million hardness and some consider 100 parts as being acceptable and economical to produce. To another question he replied that in raw water ice production the sulphate of calcium was less objectionable than sodium sulphate. Too much sulphate would produce a white shell on the ice cake.

L. H. Enslow, commented on the necessity in corrosion control of having some calcium salts present in the water regardless of the total alkalinity or pH value within reasonable limits. Examples were cited of soft waters of low alkalinity which after alkalinization had continued to corrode mains until the pH had been raised to 9.5 or higher. If that water had contained calcium bicarbonate a protective coating could have been laid down at a very much lower pH value—not over 8.4. In another instance, the alkalinity had been well up (above 100 parts) but it was practically all in the form of sodium bicarbonate, the water having been aerated to remove (CO_2). At pH values approaching 8 the water was corrosive and particularly so in hot water lines. It might be proper in some instances to intentionally add calcium salts such as the chloride and then soda ash. The carbonate of calcium produced would be laid down as the protective coating. That had been established and was already being practiced in an industrial plant suffering from corrosion of cooling coils through which the water was recirculated. If Zeolite softened water, to which lime is added to convert some of the bicarbonate of soda to carbonate of soda, had some of the unsoftened water mixed with it in precalculated proportion, a protective deposition could be had and corrosion prevented thereby.

Operating Papers

"Taste and Odor Control with Activated Carbon" —by B. F. Johnson, Chemist, New Castle Water Company, New Castle, Pa.

Mr. Johnson said that the raw water at their plant was frequently acid and contained manganese and iron. Ammonia and chlorine had been used to combat taste troubles effectively except when tastes already were present in the raw water. Sometimes the use of ammonia had not prevented certain acrid tastes from developing in the distribution system although it was effective in preventing them near the plant. He described a routine distillation test which was being used in their plant to determine what to expect in the way of tastes which might develop in the distribution system, and then displayed the equipment used. That test, using the first distillate for taste and odor test, had been the most certain way of determining the most effective treatments to employ at the plant.

With the advent of "Nuchar"—a powdered activated carbon—on the market, they at New Castle had tried it and with considerable success. The dosage being regulated to produce the best result as determined by the distillation test. The early application of powdered carbon had been to the raw water, using 0.5 grains per gallon with success. It had been added ahead of the raw water pumps and aerators. The chlorine demand had been so much reduced that chlorine could be tasted in the finished water and ammonia had been added to the filtered water to overcome this true chlorinous taste with success. More lately they had found that less carbon was required if it be added to the coagulated settled water ahead of the filters rather than to the raw water. The contact of carbon during 150 ft. travel through conduits to the filters had been sufficient. The carbon had been fed through a dry feed machine and the suspension produced had been con-

J. T. Calvert, London, Eng.

Charlie Young, District Engineer, State Department of Health, Meadville, Pa.

ducted through 300 ft. of piping to the point of application. They had since tried the carbon again to the raw water but had had on the whole better results and greater economy by returning to the applied water. The second choice had been to apply the carbon at the inlet end of the basins, but after the floc had been produced in the water. Odors in the basins had been controlled by that procedure.

The carbon treatment had been employed about 60 per cent of the time since it was started in 1930 at an average dosage of 0.2 gr. per gallon. Application of anything up to 0.25 gr. gal. just ahead of the filters had caused no shortening of runs and the filters had been in much better condition as a result. The carbon had removed considerable of the chlorine demanding substances (about 30 per cent)

I. M. Glace, District Engineer, State Department of Health, Secretary-Treasurer of the Association.

Bob Mowry, District Manager Wallace & Tiernan Co., Philadelphia, Pa.

and therefore the likelihood of after tastes developing had been reduced considerably. Ammonia applied to the filtered water had been used about 60 per cent of the time also but for the purpose of maintaining residual chlorine in the system rather than for taste control.

Mr. Johnson, stressed the value of the routine distillation test as the most effective control of taste correction measures. He felt that the results at New Castle spoke for themselves and the slight added cost for the carbon treatment was thoroughly justified.

H. B. Richards, Superintendent of the New Castle Water Company, rose to say that Mr. Johnson had hit on a most effective means of clearing up their taste troubles and he had been particularly impressed with the value of the distillation test, which was practical and fool proof. [It was as fine a compliment as a superintendent could make to his chemist and it is such support as that given by Mr. Richards that makes good chemists better and happier ones.—Editor.]

"Mud Balls and Their Elimination"—by **Edward S. Hopkins,** Principal Chemist, Bureau of Water Supply, Baltimore, Md.

Mr. Hopkins, said that the finer the sand on the filter bed surface the greater the chances were that mud balls would be found in filters. Sand with an effective size greater than 0.5 millimeters would not be so productive of mud balls and thought coarser sands than had commonly been used would be preferred in the future on that account and the better washing of the beds. The floc did not adhere to coarse sand whereas the fine sand and floc formed aglomerated particles which would gather size in the filter and produce large mud balls eventually.

Washing filters with the maximum available wash rate of 2 feet and 7 inches vertical rise of wash water per minute had produced a bed expansion of 18 per cent at Baltimore and as a result of experiences he favored the high velocity wash. In controlling period of filter wash, Mr. Hopkins advocated making a study of the turbidity of the dirty wash water sampled at intervals of 30 seconds. At Baltimore they had found a turbidity of 75 p.p.m. in the discharged wash water was an ideal figure to aim at, it being false economy to wash beyond that point. The time required to .75 p.p.m. had been determined for the various water temperatures and operators were instructed to wash a given number of minutes. Occasionally turbidity check-ups were made to determine that the filters had been washed sufficiently long. He did not predict that the same turbidity figure would apply at other plants—that being a factor to be determined locally. Mr. Hopkins said that he had been working on a theory that a two stage wash of filters using a low rate of three minutes and a high rate for about one and one half minutes would prove more effective than a single stage wash. The evidence of this which he cited was not sufficient to justify claims at this time but preliminary observations were encouraging.

In cleaning sand with caustic soda at the rate of one pound applied per square foot of filter area they had found a contact of 2 to 4 days was needed to loosen the deposit from the sand grains. The usual 48 hour period had proven insufficient. Sand taken from filters should be above a gravity of 2.6. If less he would consider the filter dirty and in need of cleansing treatment of some sort.

Questioned by R. I. Dodd as to his recommendation of a slow rate wash, Mr. Hopkins admitted that the tests so far had been too limited to justify such recommendation, but that he hoped to prove the point.

Leakage Surveys

"Results of Leakage Surveys at Reading, Pa."—by **A. R. O'Reilly,** Chief Engineer, Bureau of Water, Reading, Pa.

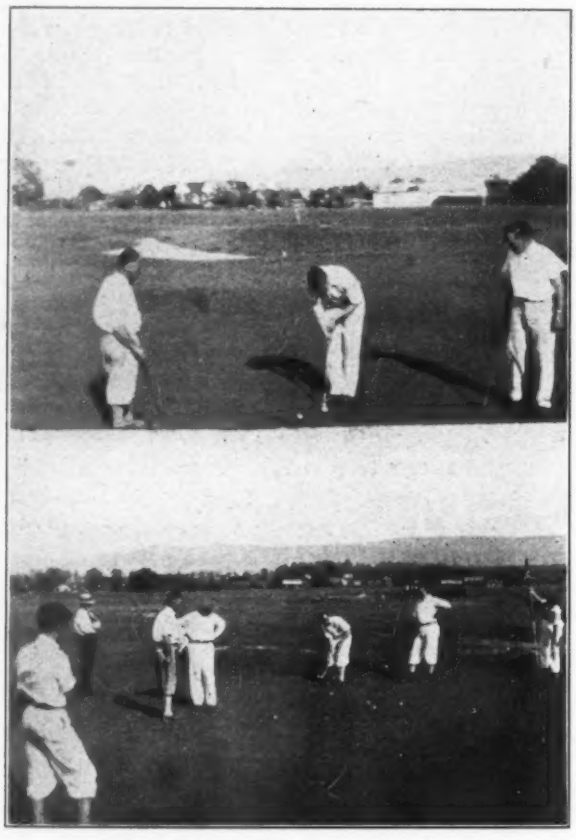
As the result of keeping at it in the matter of making leakage surveys on the mains and distribution system of Reading, Pa., the unaccounted for water has been reduced from 8.4 million gallon per day in 1926 to 2.6 million in 1931. In 1926 the leakage represented 48 per cent of the water pumped. Mr. O'Reilly said that the income from the sale of 11.5 million gallons per day in 1931 had been $516,000 and the cost of maintaining the leakage survey during that year had been but $7,330. Only 61 leaks of consequence had been found and repaired in 1931 as compared to 299 leaks in 1927 when the cost of the survey and repair work had been $12,500. He believed that $7,500 per year would cover the cost of leakage surveys continuously in Reading and felt the expenditure amply justified as result of water saved. Since 1926 the average cost per leak eliminated had been $26.22 for the patrol work and location of leak and $36.49 per leak for repairs, the total being $62.71 per leak.

Mr. O'Reilly said, that the Reading system is now 100 per cent metered and had been since 1926. In 1931 there were 26,584 meters in service and one inch meters and larger were being read monthly; the smaller meters were read quarterly. Meters one inch

or larger are tested yearly and the smaller ones are tested every 5 years.

The leakage survey is carried on by 2 patrolmen looking for major leaks, using metal rod and ear phone on the 5000 gate-valves and 16000 fire hydrants on the system. With the device a leak within one city block can be detected. In addition, all meter readers carry the same detector and listen for leaks at the curb boxes. The daily pumpage of water in 1926 had been 18.4 m.g.d. and in 1931 as a result of metering and most particularly the leak eradication program the pumpage had averaged but 11.5 m.g.d. of which 2.6 m.g.d. (22.5 per cent) had not yet been accounted for.

C. L. Fox, Assistant Superintendent, Pennsylvania Water Company, Wilkinsboro, Pa., questioned the validity of Mr. O'Reilly's calculations of the saving in dollars as result of water waste reduction. He



On the Greens Between Sessions

said that there were no customers for the water wasted and therefore the cost should not be based on the selling price of the water but on the production cost alone i.e. cost of pumping and treatment.

In reply to a queston Mr. O'Reilly said that lead joints had been responsible for considerably more leaks than had the compounds used as lead substitutes in jointing. They made a practice of filling trench bottom 6-in. and laying pipe on the new bottom. Electrolysis had been responsible for leaks to a very minor degree. As to material used for house service lines, there had been no regulation except that the pipe should not be of steel.

The Chair called on **H. E. Beckwith,** Engineer, The Pitometer Company, Harrisburg, Pa., to comment on the value of ear-phone surveys vs. Pitometer surveys. Mr. Beckwith said that the Pitometer survey was a matter of making a complete audit systematically of definite sections of a distribution system or force main. The only difference between the two procedures that he could see was about 3 years and 8 months. What had been accomplished in 4 years might be done in 4 months with a Pitometer Survey. In other words, the Reading Curve of water pumped would have come down much more rapidly i.e. the unaccounted for water (leakage) would have been more promptly and effectively detected and eliminated.

After giving a note of appreciation to the officers and particularly to Secretary I. M. Glace, the meeting adjourned.

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The Water Witchers Convene

Water and Water Engineering of London in its issue of April 20, 1932, gives the following report of the first international congress of diviners held at Verona, Italy, in March:

"The congress was opened by a delegate representing the Italian Ministry of Agriculture. Two hundred Italian and foreign students and diviners were present. The congress was held with the purpose of finding, if possible, a scientific interpretation of the phenomena of rhabdomancy. Its members were mostly Italian, German, Austrian and French university professors, but there were also some monks, one from Armenia and two from Switzerland, several women, some peasants, and some artisans. The first to read a paper was a Swiss Father, Dr. Arnold, who gave information as to the development of rhabdomancy in his country, and the effect of the supposed radiations of underground waters on human health and the health of animals, particularly cattle. Dr. Beyer, of Berlin, who followed, thought that rhabdomancy can be explained by considering the human organism as a kind of transmitting and receiving apparatus of an electro-magnetic wave of various frequencies. Prof. Cazzamalli, of the University of Milan, put forward the theory that the human brain, under special and uncommon activities, is the source of the phenomenon. It should be scientifically considered as a metaphysic phenomenon. This theory was challenged by Dr. Casu, of Verona, who believed that the phenomenon was purely physical. Any substance capable of radiating electro-magnetic energy produced a muscular contraction made visible by the movement of the rod. Rhabdomancy, he believed, would bestow many benefits, not only in connection with the discovery of underground waters and minerals, but also with regard to biological sciences, particularly in the field of climatology and hydro-mineral therapeutics. The congress reached the conclusion that the phenomena of rhabdomancy was established, but that it is necessary to distinguish them from the charlatanism which might discredit rhabdomancy in the eyes of the public. It therefore passed a resolution proposing the creation of a union of diviners, only those admitted to this union and holding a diploma from it to be recognized. In Italy this resolution means the entrance of rhabdomancy into the manifold organization of the corporative State."

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ADVANTAGES OF METERAGE.—The Ohio Health News for July 15 states that where meters have been installed in Ohio cities that previously had been entirely unmetered, water consumption has almost always been reduced to 50 per cent of the former consumption. In some instances the reduction has been to 25 to 33 per cent of the amounts previously used, thus demonstrating the antecedent enormous waste.

FILTRATION PLANTS

A Section Dealing with Their Design, Construction and Operation

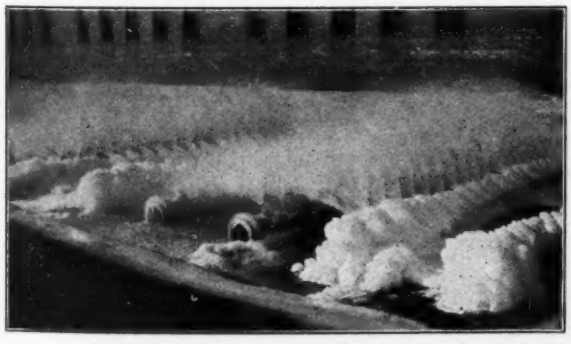
Conducted by JOHN R. BAYLIS, Associate Editor
Physical Chemist, Bureau of Engineering, Chicago, Ill.

AERATION

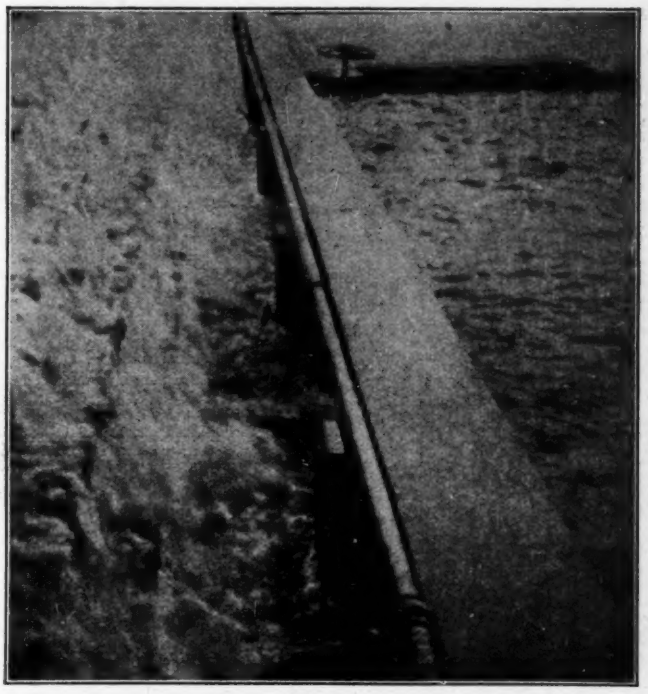
Part 3. Present Practice of Aeration

THE effect of films at the water-air interface and compounds which may be removed from water by aeration were discussed in the June and July issues of WATER WORKS AND SEWERAGE. The present article will be largely a digest of current practice in aeration in so far as it is described in the technical literature. It is known that only a small percentage of the aerators have been described, but it is believed that such descriptions give a very good indication of prevailing practice throughout the country. It is not the purpose of these articles to advocate one type of aerator over another. Usually the question of whether or not to install aerators and what type should be used has been left to designing engineers. The purpose of these articles is to give some of the fundamentals which should be taken into consideration, and to give prevailing practice in this country.

What the several types of aerators will accomplish should be known in order to determine the most suitable type for each particular condition. There is so little known about aeration at the present time that some of the water works may, or perhaps have, installed aerating devices when their troubles may be more effectively and more cheaply eliminated by chemical treatment of the water. Also devices have been installed in which it should be evident that efficient results cannot be obtained. It is hoped that these remarks will not retard the construction of aerators where aeration is the cheapest and most effective means of accomplishing the desired results. It is to help prevent the designers of water works structures from including aeration in the design when they have no idea what good might be accomplished by aeration and merely include it in the design to have it there in case it might be needed, as has been the case in several instances.



Filtered Water Aerator, at Providence, R. I., Winter Operation Showing Ice Formation



Step Type Aerator, Norfolk, Va., Activated Carbon Applied to Discharge

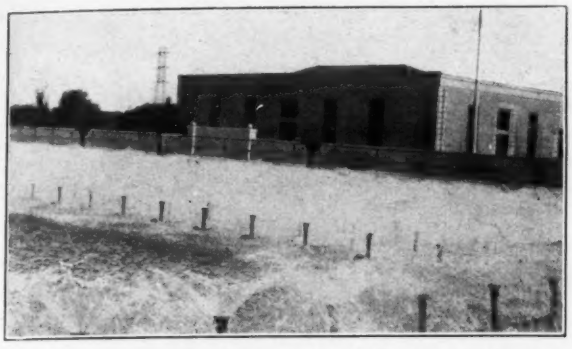
Purposes of Aeration.—Reasons for aeration may be classified under four main purposes—(1) removal of objectionable odors, (2) removal of carbon dioxide, (3) removal of iron and manganese, and (4) to restore oxygen to the water. The presence of iron and manganese is usually associated with ground waters which are high in carbon dioxide and deficient in dissolved oxygen. Aeration removes carbon dioxide and at the same time it adds oxygen to the water which converts the soluble iron and manganese compounds to insoluble products. Sometimes the agitation given to the water by aeration is utilized to bring about more rapid mixing of the chemicals with the water. Frequently the main reason for aeration is to remove objectionable odors from the water, yet at the same time a deficiency in dissolved oxygen may be restored and an excess of carbon dioxide removed.

The use of air for lifting water out of deep wells is in common use. This usually results in the removal of a large percentage of the carbon dioxide and restores dissolved oxygen which will cause the iron, if any is present, to be precipitated. Also it makes the water less corrosive to the service pipes. Thus it is seen that the question as to whether a water should or should not be

TABLE I—AERATING SYSTEMS FOR THE REMOVAL OF OBJECTIONABLE ODORS

City	Date Article Published	Reference No.	Description of Aerator.
Danville, Ill.	1922	1	There are 6 fountain aerators consisting of vertical pipes near the top of which are placed perforated boiler plates with conical hoods. The fall of the water is 5 ft.
Lynchburg, Va.	1925*	2	Circular ring nozzle type. Aeration removes odoriferous gases and reduces the CO_2 from 25 to 3 p.p.m. *See also 1932 installation of "Aeromix" system.
Ft. Worth, Texas	1925	3	There are 64 Spraco nozzles on 5 independent pipe lines. 10 pounds pressure gives a discharge of 150 gallons per minute for each nozzle.
Topeka, Kan.	1925	4	Multiple pan type with a total weir length of 900 ft. and a drop of 15 ins.
Orlando, Fla.	1926	5	16 aerating nozzles are located over the mixing basin.
Ft. Pierce, Fla.	1927	6	The aerating device consists of 12-in. pipes having ½-in. holes drilled in the top. The water is discharged vertically, falling back on itself, flows around the pipes in thin sheets, and then drops from the bottom.
Fostoria, Ohio	1928	7	29 nozzles are located on three lines of 8-in. pipe. Each nozzle has a capacity of 75 gallons per minute.
Southern Pine, N. C.	1928	8	The filtered water is sprayed onto the roof of the clear water reservoir.
Peterborogh, Ont.	1928	9	The aerator consists of a series of six steps, down which the water passes in thin films. The total head lost is 5 ft.
Waterford, N. Y.	1929	10	There are 21 spray nozzles. 15 of the nozzles are provided with shut-offs. 11 nozzles will carry a load of 1.2 million gallons daily.
	1930	12	
Waukegan, Ill.	1930	11	Air is sucked by the water flowing past hundreds of tube ends in the "Aeromix" aerator and the mixture of air and water is discharged about 20 ft. below the surface of the water in the mixing chambers.
Menasha, Wis.	1930	13	There are 32 spray nozzles of 100 gallons per minute capacity mounted on a manifold system of piping.
Syracuse, N. Y.	1931	14	Spray nozzles are located in a distributing reservoir.
Charleston, W. Va.	1931	15	Ten 8-in. riser pipes extend from a header on the bottom. One-inch air lines extend into each header and air under 10 lbs. pressure is forced into the riser pipes. The average air supplied was 0.11 cu. ft. per gallon of water.
St. Paul, Minn.	1931	16	Air is forced through pipes lying upon the floor of the mixing chamber. There are two pipes approximately 12 ft. long, which is the width of the mixing chamber. Staggered and at an angle of 45 degrees with each other are drilled two rows of 3/16-in. holes. Air at the rate of 6,000 cu. ft. per million gallons under approximately 5 lbs. pressure is forced into the water.
Mamaroneck, N. Y.	1930	17	The filtered water passes over an open ripple plate aerator and thence into the clear water reservoir.
	1931	18	
Cedar Rapids, Iowa	1930	19	Spraco nozzles having a discharge of 115 gallons each per minute under 15 ft. head are attached to a header running around the mixing basin. The water falls into the mixing basin.
	1932	20	
Iola, Kan.	1930	21	Sacramento type spray nozzles are used. The discharge falls into the carbonating chamber below.
	1930	22	
Univ. of Florida, Everglades Exp. Station	1932	23	Coke tray type aerator is supplied with water from the Hillsboro canal.
Manhattan, Kan.	1931	24	The aerator is of the pan type with a total weir length of 210 ft.
Hartford, Conn.	1922	25	The aerator is a circular basin about 40 ft. in diameter into which the water falls after being sprayed into the air with fountain-like jets.
Sacramento, Calif.	1922	26	The aerator nozzles have floating cones in the central part which produces a thin sheet of water for all discharges.
Sacramento, Calif.	1929	27	There are 420 aerators spaced 4 ft. centers. The water drops 3 to 6 ft.
Virginia Beach, Va.	1922	28	(See iron and manganese removal.)
Lynchburg, Va.	1932	29	Since 1919 the objectionable odors have been removed very successfully with whirling spray nozzles. 50 ft. of head was used. An Aeromix of a capacity of 6 million gallons was installed on top of the coagulating basin and gives considerable saving in the cost of operation.
Neodesha, Kan.	1932	30	The mixing tank is hopper bottomed and holds 10 minutes' flow. Combined mixing and aeration is effected by compressed air applied through perforated brass pipes laid on the tank bottom.
New York, N. Y.	1931	31	There are aerators at both the Ashokan and Kenseco reservoirs with 1,600 nozzles each. At Ashokan all the water amounting to 600 million gallons daily is passed through the aerators. At Kenseco two-thirds is aerated, this amount being the capacity of the aerator. The aerators are a beautiful part of the Catskill system, but are not essential.
Sheboygan, Wis.	1930	32	Spray nozzles are used.
Joliet, Ill.	1914	33	The water from a deep well was impregnated with oil and gas. At one end of a reservoir a series of steps was constructed for the water to flow over. The reservoir 75 ft. long. was divided into 6 ft. compartments so the water flowed under one baffle and over the next one. Air was delivered to each compartment through perforated pipes resting on the bottom of the reservoir. The air bubbling up brought the oil to the surface.
Richmond, Va.	1924	34	There are 300 spray nozzles. It was found that the spray aerators removed as much as 90 per cent of the chlorine added a few seconds before aeration.
Providence, R. I.	1927	59	The nozzles are attached on the filter effluent pipe. Spray nozzles sufficient in number to discharge the rated capacity of the filter when clean are provided, and also a variable nozzle which opens gradually to maintain the rate of filtration. Carbon dioxide and gases productive of taste and odor are reduced. The available head is 10 ft. Similar aeration used on the raw water.
Oklahoma City, Okla.	1924	60	The water is delivered to 48 6-in. cast-iron riser pipes extending 5.5 ft. above the aerator floor. Each riser pipe supports three cast-iron pans, and the water falls from the top of the riser pipe successively over the three pans to the floor of the aerator. A secondary aerator constructed on the top of the clear well consists of 81 3-in. turbine center-jet bronze nozzles.
Kansas	1926	61	The Kansas State Board of Health has evolved a simple type of timber aerator consisting of an inverted V-stack of horizontal staggered baffles which provide a cascade of the water giving an even distribution and fine separation of the flow. Several Kansas plants have constructed this type of aerator.

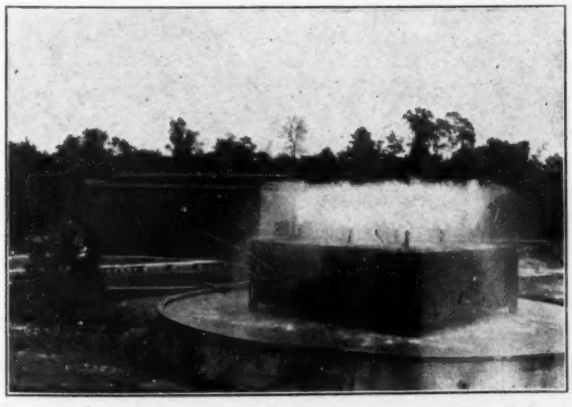
aerated may depend upon several factors. If the cost of pumping water from wells by air is the same as that of deep well pumps, and the water is improved by aeration, the air-lift method of removing the water from the well should be given preference. This, however, is not to start an argument as to best method of lifting water from deep wells, for the water pumped by deep well pumps can be effectively aerated after it has been pumped above the ground. It is merely to state that the CO_2 removed and the oxygen added to the water should be taken into consideration in determining the most economical system to use.



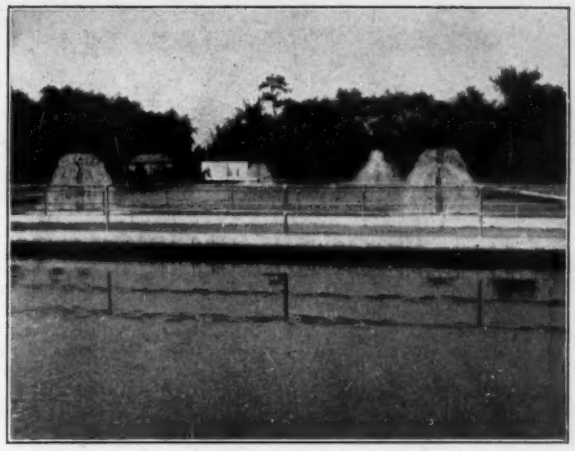
Aerator at Sacramento, Calif., Showing the Nozzles Developed There, Having Floating Cones

Aeration for the Removal of Odors.—It is believed that most of the aerators which have been constructed heretofore have been for the removal of objectionable odors from water. Almost every conceivable means of aerating water has been tried. It is believed that decidedly the larger number of aerating plants use spray nozzles, and it appears that the Spraco or Badger type of nozzle is used most extensively. Aeration so often serves more than one purpose that it is difficult in many instances to classify the aerator according to its main use.

Most of the aerators constructed for the removal of odors were constructed before taste and odor elimination treatments were developed. In fact, it is just now being demonstrated that aeration for the elimination of objectionable odors is no longer necessary. Aeration for the elimination of odors is in many instances only partially successful. It seems that some of the odors may be reduced to where they are not very objectionable, yet there are not many instances where a very pronounced odor is reduced by aeration to the point where it cannot be detected. The treatment processes which



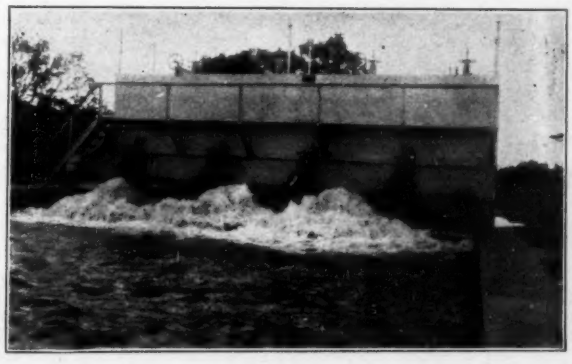
Aerator Nozzles with Coke Contact Bed Beneath. Iron Removal Plant, Lufkin, Tex.



Aeration Basin, Atlantic City, N. J., Water Works

recently have been developed are usually capable of completely eliminating both tastes and odors without the aid of aeration. It is too early to predict the extent to which aeration will be abandoned as a means of reducing objectionable odors from water, though it seems probable that its use will decrease rather than increase, even though the demand for more palatable water is increasing. Table I gives a digest of some of the plants using aeration for removing objectionable odors.

Aeration for CO_2 Removal.—In a number of instances the reduction of carbonic acid in the water is one of primary reasons for aeration, and in some plants it is the only reason. It would be difficult to state the CO_2 content above which it is economical to aerate, for this will vary depending upon conditions. The writer is of the opinion that in nearly all instances where there is free CO_2 in the water it is more economical to remove or chemically neutralize it. This is not strictly true for hard and fairly hard waters, though the amount of CO_2 which may be left in hard water without detriment is low. Where the CO_2 content is low it usually is more economical to neutralize it with lime or soda, but when it is high it would be better in most instances to remove part of the CO_2 by aeration and neutralize the balance



"Aer-o-Mix" Aerators at Nashville, Tenn. Three Units of 10 MGD Each

by chemical treatment. It is believed that 10 p.p.m. of free CO_2 is near the dividing line between where chemical treatment only should be used and where aeration and chemical treatment both should be used. There, of course, are instances where aeration should be used when the CO_2 is less than 10 p.p.m., but in most of these aeration is expected to accomplish more than the removal of CO_2. Table II gives some of the water supplies where aeration is used to reduce the free CO_2.

TABLE II—AERATION FOR THE REMOVAL OF CARBON DIOXIDE

City	Date Article Published	Reference No.	Description of Aerator.
Miami, Fla.	1927	35	There is an annular inlet channel running around the circular mixing tanks. The water flows over a lip and splash plate arranged so as to provide two falls before reaching the water level in the tank. The aeration has resulted in saving approximately 250 pounds of lime per million gallons.
Memphis, Tenn.	1927	36	The water passes through a riser pipe and is distributed equally through a quadrant. It then drops through trays, of which there are 40 to each quadrant. The bottoms of the trays are made of cypress strips about ½ by 1 in., and ½ in. apart. The trays are filled with coke.
Sacramento, Calif.	1929	27	(See aeration for odor removal.) In an effort to reduce the carbon dioxide, coagulation before aeration has been successfully demonstrated.
W. Palm Beach, Fla.	1930	37	Spray jets are used. The alum treatment liberates approximately 24 p.p.m. of CO_2. The water is sprayed before being allowed to coagulate. The first aeration liberates approximately 16 p.p.m. of carbon dioxide. The water is again sprayed after filtration which reduces the carbon dioxide to approximately 5 p.p.m.
Virginia Beach, Va.*	1922	28	(See iron and manganese removal.) The CO_2 was reduced from 125 to 20 p.p.m.
Kokomo, Ind.	1931	38	(See iron and manganese removal.)
Univ. of Florida, Everglades Expr. Station	1932	23	(See aeration for odor removal.) The free CO_2 varies from 8 to 72 p.p.m. The maximum is reduced to 10.
Lynchburg, Va.	1925	2	(See aeration for odor removal.) The CO_2 is reduced from 25 to 3 p.p.m., thus reducing soda ash involved.
Orlando, Fla.	1926	5	(See aeration for odor removal.)
Ft. Pierce, Fla.	1927	6	(See aeration for odor removal.) Some of the free CO_2 is removed.
Waterford, N. Y.	1929	10	(See aeration for odor removal.)
Mamaroneck, N. Y.	1931	18	(See aeration for odor removal.)
Martin, Tenn.	....	40	The water is obtained from a deep well and is aerated by a spray aerator. The aerator consists of a 4-in. brass pipe bent to form a circle on top of the circular reservoir wall. On the inside of the pipe circle there are 2,100 holes 3/32-in. in diameter at 40 degrees from the horizontal. The result is a deep fine mist. The free CO_2 is reduced from 46 to 12 p.p.m.
Waterford, N. Y.	1930	12	(See aeration for odor removal.) Tests indicated that good aeration would save nearly enough soda to offset the pumping cost. The nozzles are Binks No. 7, and all the pipe work is cast iron. The CO_2 in the water before aeration was from 8 to 26 p.p.m., and after aeration from 4 to 10 p.p.m. Reduction was as high as 84 per cent in August and only 60 per cent in December.
Danville, Va.	1920	41	The treated water supplied by the low-lift pumps is diffused by 37 nozzles each with 1 3/16-in. orifice. The raw water has free CO_2 content of 1½ to 4 p.p.m., and the coagulant increases it. The aeration in turn lowers the CO_2 to approximately that of the raw water.

*Plant has since been abandoned. Water is sold to the town by Norfolk, Va.—Editor.

Iron and Manganese Removal.—Aeration is an important step in removing iron and manganese from water. It would not be practical to try to remove these compounds from water which contains no dissolved oxygen unless oxidation is accomplished by chlorination. Most waters naturally containing dissolved oxygen will not contain iron in solution, but this is not always the case with manganese, though waters high in dissolved oxygen content usually do not contain much manganese in solution. Not many natural waters are so acid that the iron present will not be converted to insoluble ferric compounds when dissolved oxygen is present. The water would have to have a pH less than 4.0 for iron to exist in the soluble state in the presence of dissolved oxygen. This does not mean that there will be immediate precipitation of the iron when dissolved oxygen is restored to the water by aeration, for when the pH and the iron content are fairly low the formation of a precipitate is very slow. When the pH is below about 6.0 the formation of a precipitate is so slow even when considerable iron is present that it would not be completely removed in the usual treatment plant. One of the aids given to the precipitation of iron by aeration is the increase in pH resulting from lowering the CO_2 content.

There are several references in the literature to over-aeration. In a few instances where the water containing iron passes through contact beds it seems that the beds do not function as well when there is excessive aeration as when there is only gentle or partial aeration to preclude a finely divided precipitate of iron. The iron is then adsorbed to a more effective degree on the contact surfaces—particularly so in contact with the films of

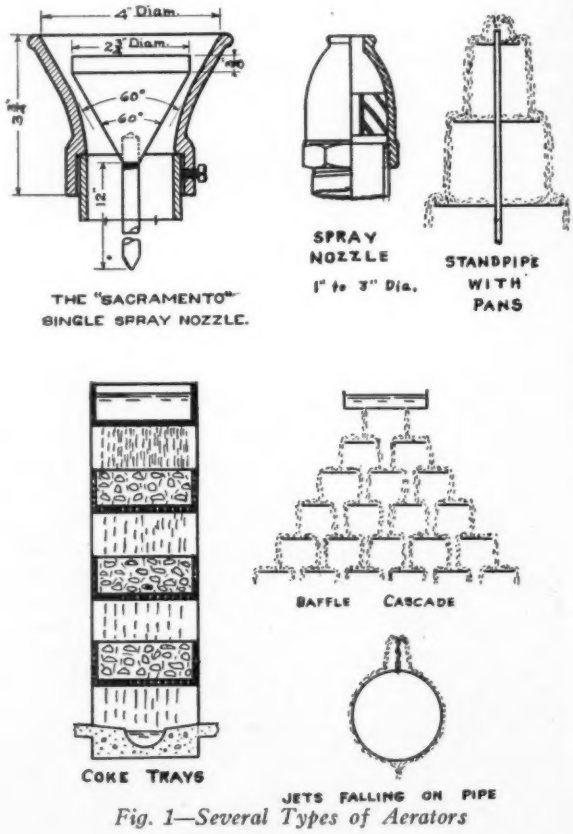


Fig. 1—Several Types of Aerators

precipitated iron. There are also indications that over-aeration interferes with biological growths conducive to iron deposition in contact beds.

Aeration probably will continue to be the cheapest and most effective means of bringing about oxidation of the iron compounds in water. It also restores dissolved oxygen to the water which is desirable for all potable supplies. Table III gives some of the cities where aeration is used in connection with the treatment to remove iron and manganese from the water.

Aeration for Hydrogen Sulfide Removal.—Hydrogen sulfide is fairly soluble in water and it is not expected that it will be completely removed by aeration. It is more than twice as soluble as carbon dioxide and has a slightly higher boiling point, consequently the reduction by aeration should not be as great as for carbon dioxide. There is not much specific information on the reduction of hydrogen sulfide, but what information there is indicates that the percentage removal is less than for carbon dioxide. Hydrogen sulfide, however, is gradually oxidized if the water contains dissolved oxygen and while the removal as a result of aeration may eventually be complete, it is not all removed directly by the gas escaping into the air at the time of aeration. The alkalinity of the water has considerable bearing on the efficacy of sulfide aeration. Table IV gives several places where aeration is used to aid in the removal of hydrogen sulfide.

TABLE III—AERATION FOR IRON AND MANGANESE REMOVAL

City	Date Article Published	Reference No.	Description of Aerator.
Watertown, Mass.	1900	42	The water is drawn from tubular wells and aerated by passing through wooden boxes with perforated bottoms.
Marblehead, Mass.	1900	42	Iron has caused trouble in the water drawn from an open well. Two wooden boxes with perforations were placed above the filters. The boxes were 2.5 and 5.5 ft. above the sand.
Prenzlau, Germany	1900	43	The aerators are metal troughs with perforated bottoms and sides through which the water passes to screen troughs which have corrugated and perforated plates. The water falls from these to the top of a brick checkerwork 9.8 ft. high. The brickwork has given results comparing favorably with coke. This method has been used for 6 years at other places.
Reading, Mass.	1906 1927	44 45	System not described, but it is stated that the water could be over-aerated. Weston stated it was found that the laws of oxidation apply differently in the case of waters containing manganese than they do in the case of waters containing iron. He found that the oxidation of iron failed when the water was aerated to such a point that leptothrix ochraceae would not grow in a trickling filter.
Memphis, Tenn.	1927	36	(See Table II, CO_2 removal.)
Lowell, Mass.	1927	45	Barbour found that manganese could not be removed with iron when aeration was carried so far that the carbon dioxide was reduced to the practicable low limit.
London, England	1922	46	A small quantity of air is injected into the water from wells by compressed air at Waltham Abbey and Rammey Marsh. The water is then filtered through a bed of polarite and sand.
Stuart, Fla.	1928	47	Spray aerators are located on roof over the upward flow gravel contact beds and clear well. Over-aeration prevented the most efficient iron deposition in the beds.
Wausau, Wis.	1928	48	The aerator consists of shallow wooden racks, holding 5-in. layers of coke and 2-in. layers of manganese dioxide ore, which are arranged in vertical tiers.
Sioux Falls, S. D.	1930	49	The aerator is of the weir-step type, in which the water cascades down concrete steps on which removable 1½-in. pipes are placed to break up the stream.
La Porte, Ind.	1930 1930	50 51	The aerator consists of 64 Sacramento type nozzles discharging above a concrete splash tray.
Kokomo, Ind.	1931	38	The aerator consists of 4 series of coke trays with 5 trays in each set. The water is discharged over the trays by means of perforated pipe. The steel trays are approximately 5 by 2 ft., and the bottom of each is perforated with 296 15/16-in. holes.
Baco Raton, Fla.	1931	39	The aerator consists of a steel angle weir, 11 ft. long, over which the water cascades onto two steel plates arranged in steps to give the maximum splash effect. The head consumed in aeration is 2 ft.
Shelby, Ohio	1921	52	The aerator comprises three horizontal trays containing crushed coke. The trays are each 4.5 by 9 ft., and are 12 in. deep with 12-in. clearance between the trays. The bottoms are covered with wire screen containing 3½ meshes per square inch composed of iron wire 0.105 in. in diameter.
Virginia Beach, Va.*	1922	28	The aerator consisted of 4 Spraco nozzles. The nozzle pressure was 6 lbs. The iron was reduced from 2.2 p.p.m. in the raw water to 0.05 p.p.m. in the filtered water.
Cohassett, Mass.	1914	53	The water passes from an aerator into a trickler of coarse coke 10 ft. deep designed to operate at 75 million gallons per acre per day. The trickler is piped so as to work submerged, partly submerged, or nonsubmerged.
Punta Gorda, Fla.	1930	54	The water is pumped to the top of a square wooden tank 5 ft. wide, 10 ft. long, and 4.5 ft. high. The tank is filled two-thirds full of broken pieces of terra-cotta pipe, over which the raw water is distributed through 12 ½-in. holes tapped into a 4-in. pipe. The discharge from the tank is regulated to give the desired submergence of the broken pieces of terra-cotta pipe. It was necessary to prevent excessive aeration.
Middleboro, Mass.	1914	53	The aerator consists of a system of piping connecting the discharge from the low-lift pumps with 37 2-in. nipples. On each nipple is screwed a cap drilled with 24 3/16-in. holes, and pressed to make the surface convex and the axis of the holes radial. These sprays discharge upward, discharging the water on the surface of a layer of coke 10 ft. deep contained in a concrete tower 28.3 ft. in diameter.
Lansing, Kan.	1932	62	A splash pan aerator followed by a cascade effect was replaced by an "Aer-O-Mix" unit requiring 6 ft. of head as compared with 11 ft. for the previous aerator. The iron content in the settled water has been reduced to 0.2 p.p.m. as compared with 2 p.p.m. before the change. Chemicals required for coagulation have been materially less since the change. The coagulated settled water is used without filtration.

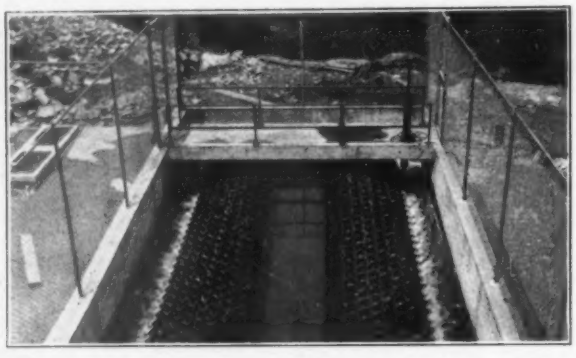
*Water from Norfolk, Va., supply now furnished Va. Beach.

TABLE IV—AERATING SYSTEMS FOR THE REMOVAL OF HYDROGEN SULFIDE

City	Date Article Published	Reference No.	Description of Aerator.
Beverly Hills, Calif.	1928 1929	55 56	The aerator consists of 90 Sacramento type nozzles. The nozzles give a satisfactory spray but do not cause complete reduction of the hydrogen sulfide. An inlet water which ranged from 6.0 to 10.0 p.p.m. of H_2S was reduced to 3.5 to 4.0 p.p.m. Retention of 4 hours in the basins gave a marked reduction. Blowing air through the water gave negative results, except after long retention. Best results were obtained when the sprayed water trickled about ½ in. deep over the floor slab. The aeration takes place in a closed chamber connected to a tall stack having artificial draft.
Sarasota, Fla.	1929	57	The discharge from the wells is through Badger spray heads which aerate the water and remove the hydrogen sulfide.
Daytona Beach, Fla.	1931	58	The water is pumped through an aerator located about 4 ft. above a 75,000-gallon reservoir. The water falls over a splash board into a series of baffle plates causing a fine spray. When the reservoir becomes filled an air agitation system consisting of a network of perforated pipes is turned on.
Kokomo, Ind.	1931	38	(See iron and manganese removal.)

The aerating systems referred to and described in the tables are not intended to include all systems which have been described in the literature. It is hoped that enough plants have been described to give some idea of the variety of designs which have been used. Very likely some of the systems have been changed since the articles were written, and for this reason not many systems constructed years ago have been described. The plants described in the tables should not give one the impression that the various designs are in proportion to their number in the tables, for the tables may not indicate that the spray type of aerators are decidedly in the majority. Some of the types of aerators or spray nozzles are illustrated in Fig. 1.

No Certain Type of Aerator Can Be Recommended.—There is not enough specific data on what aeration accomplishes to give much information on the most economical type. In fact, the most economical type may depend somewhat upon the water, the layout of the plant, and what the aeration is expected to accomplish. When one considers the factors controlling the rate of gas escape from water by exposure to air it is evident that an enormous water-air surface must be formed if the aeration is efficient. It probably makes little difference in most instances whether the surface is formed by spraying water into the air or by forcing fine bubbles of air into the water.



Riffle Type of Aerator at Mamaroneck, N. Y., Filter Plant. (Photograph Taken During Very Low Flow)

It is believed that a considerably larger surface is formed by a spray that breaks the water up into small drops than by any other method, though it is possible to force enough fine bubbles of air into the water to produce the same surface area. In fact, it may not require an equal surface area to produce the same results, for the bubbles of air are usually in contact with the water much longer than the drops of water are in contact with the air. It was stated in Part 1 that the experimental data indicated that the thinnest surface film was on the drop of water. It may be that the rate of transfer of dissolved gases through the thin film around the drops is much more rapid than through the thicker film which surrounds the bubbles of air.

Beds of coke and coke trays are used quite frequently for securing carbon dioxide release and oxidation iron removal plants. The water is sprayed over the coke and it then percolates down through the bed. Where trays are used there are usually a series of trays filled with coke, the water being sprayed on the upper tray falls through the perforated bottom to the next lower tray and so on to the bottom. The water is later filtered to completely remove the iron. In other instances slow upward flow through gravel contact beds is employed.

The "Aer-o-Mix" has been installed in a few water works. This system of aeration sucks fine bubbles of air into the water through numerous small pipes located where the water flows into the device. This is illustrated in Fig. 2. It appears to be a satisfactory means of aerating water and under certain circumstances has been reported to be more economical to operate than spray types of aerators. The selection of an aerator, however,

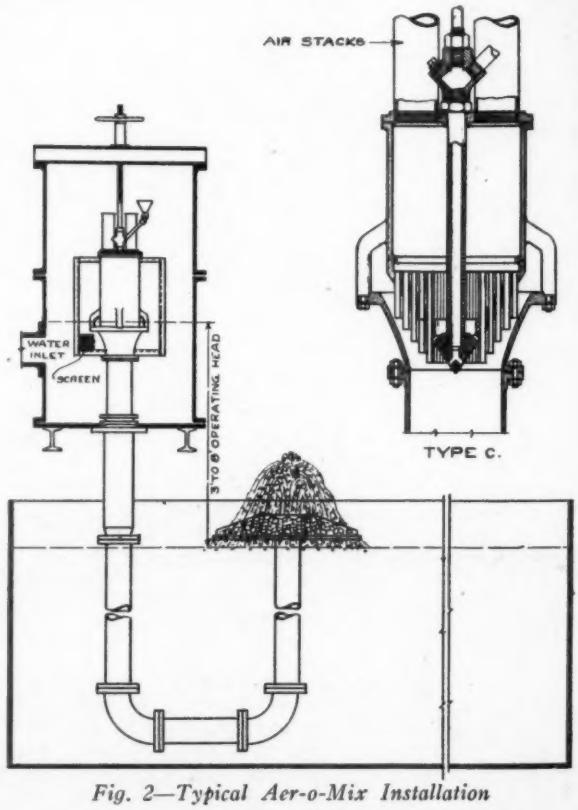


Fig. 2—Typical Aer-o-Mix Installation

is still largely a matter of choice to meet specific conditions.

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An Acknowledgment

We wish to correct an oversight by our printers. The name of **C. E. Keefer,** author of the article, "Sludge Disposal at the Baltimore Sewage Works" on page 225 of WATER WORKS AND SEWERAGE for July, was unintentionally omitted.

C. C. Hommon Returns to Canton, O.

The City Council at Canton, O., some months ago abolished the position of Superintendent of Sewage Treatment Works which was held by C. C. Hommon. Recently the council has re-established the position and Mr. Hommon has returned.

INDUSTRIAL WATER SUPPLY ·AND TRADE WASTES·

RAPID DETECTION OF RATES OF CORROSION WITH SIMPLIFIED APPARATUS

By CLOYD M. CHAPMAN

Consulting Engineer and President,
American Society of Testing Materials,
205 W. 39th St., New York City

Cloyd M. Chapman

PREPARATION of the surface of corrosion test specimens of metals and alloys by pre-test polishing to a sufficient degree to permit microscopic detection of the character and progress of the corrosive attack offers a means for making quick determinations of the relative suitability of materials to resist corrosion.

Such a method has been successfully used by the author. In one case a plant was being built for the reclamation of heat by direct contact between water and the flue gases. It was necessary to know promptly the corrosive action of the water impregnated with flue gases at various stages of the process. Three available materials were economically suited for construction of water line. Specimens of steel, wrought iron and Toncan iron were prepared and inserted in the lines of the "pilot" plant. After 24 hours the specimens were removed and examined and compared under the microscope at about 50 magnifications. They arranged themselves in the order of Toncan, wrought iron and steel, Toncan showing greatest corrosion resistance, steel the least. Toncan iron was used in the construction and has proven its superior adaptability for the service. At a later date a 2½ hour test in the finished plant with another set of specimens of the same materials gave the following results:

Steel—Areas of definite and rather deep grain outline etching covered a large portion of the (polished) surface.

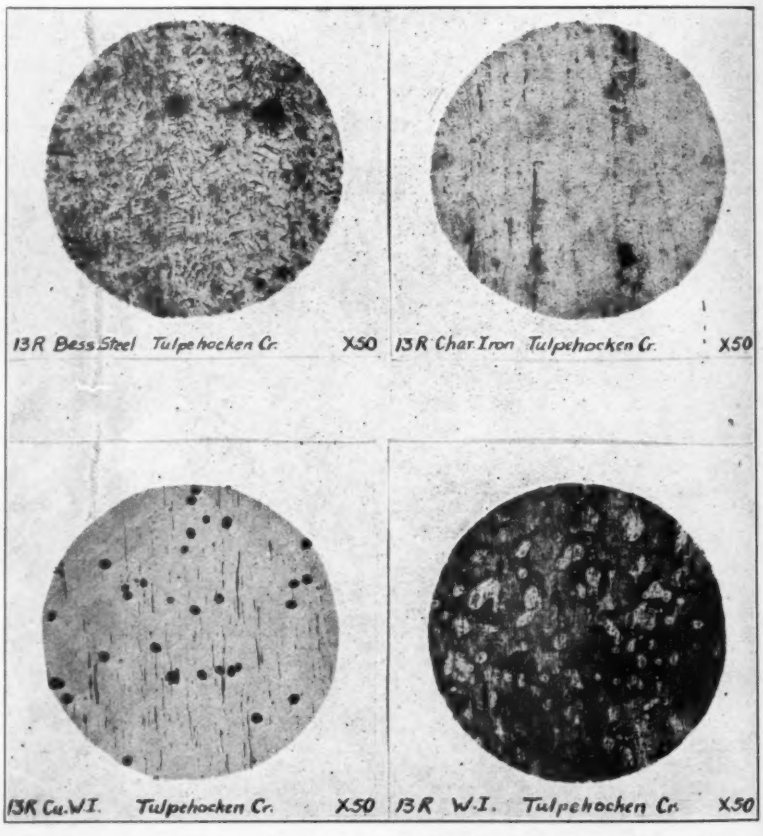
Wrought iron—Irregular shallow pits were forming on the surface, showing a tendency to spread.

Toncan iron—Very little or no indication of corrosion.

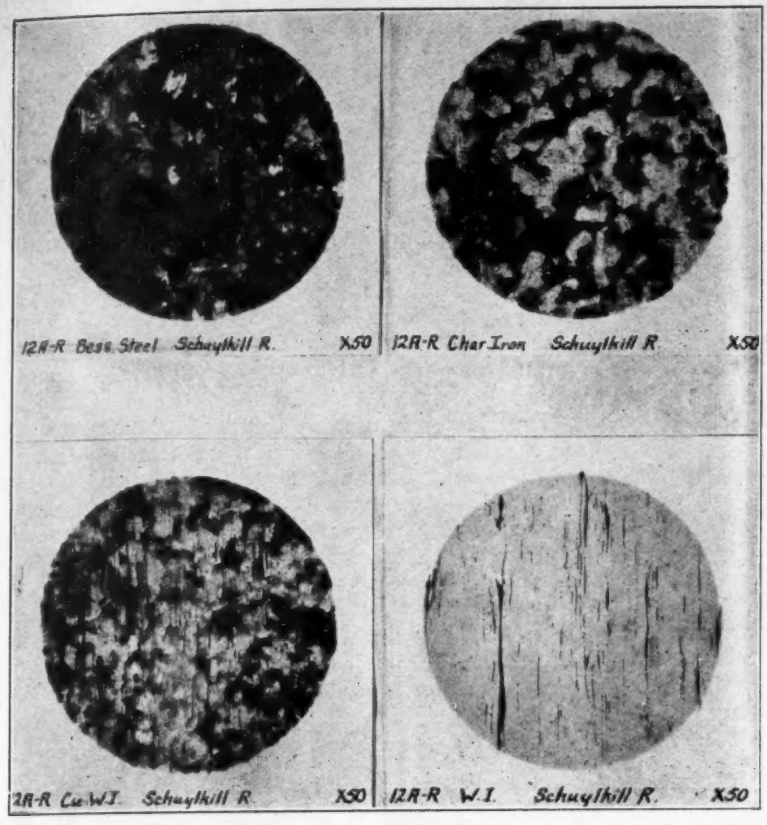
Heat reclamation from an extremely corrosive process-water had earlier presented another problem relating to materials of construction. Two years of experimentation with heat exchange tubes of a large variety of materials in actual service resulted in the selection of Muntz metal for its high corrosion resistance, with other brasses and galvanized irons and steels, following with various degrees of lessening resistance.

On development of the polished specimen method of test, samples of a portion of the materials tried in the two-year test were prepared and subjected to similar conditions. Among the brasses Ambrac, Admiralty and Muntz were selected for trial, and among the ferrous metals galvanized Toncan and black steel were chosen. The selection was intended to cover the range of corrosion resistance shown by the two-year test.

At the end of 16 hours' exposure of these specimens to the corrosive water they arranged themselves, according to microscopic examination of the polished test surfaces, in the following order of decreasing resistance to corrosion: Muntz and Admiralty did not show a sufficient distinguished differ-



Figs. 1, 2, 3, 4—Test in Water from Tulpehocken Creek (Pa.), an Alkaline Water Free of CO_2 But Containing 0.92 Parts Per Million of Dissolved Oxygen



Figs. 5, 6, 7, 8—Test in Water from Schuylkill River Very High in Sulfides and Containing 3.9 p. p. m. of CO_2 and 11.2 p. p. m. Dissolved Oxygen

ence between the two to rate one better than the other; Ambrac, galvanized Toncan and galvanized wrought iron, did not reveal a difference, in this time period, sufficient to distinguish a superiority of one over the other. Steel was the least resistant. The examination was made and the order of arrangement established by a person not familiar with the result of the two-year tests. The results of the microscopical test checked remarkably well with the order of resistance revealed in the two-year test.

That the test is very delicate is indicated by the fact that but a few hours' exposure may be sufficient to indicate a difference in the extent of corrosion produced by minor differences in the quantity of corrosive elements present.

The photomicrographs shown in Figs. 1 to 12 exhibit the results of laboratory tests of four materials exposed to three natural waters, such as might be handled in any pumping or distributing system. In each test like specimens were prepared from the same materials, Bessemer steel, charcoal iron, copper-bearing wrought iron and hand-puddle wrought iron. Each specimen was separately immersed for 20 hours at room temperature.

Figs. 1 to 4 show specimens subjected to Tulpehocken Creek water, which tested alkaline, free of carbon dioxide, but contained 9.2 parts per million of dissolved oxygen.

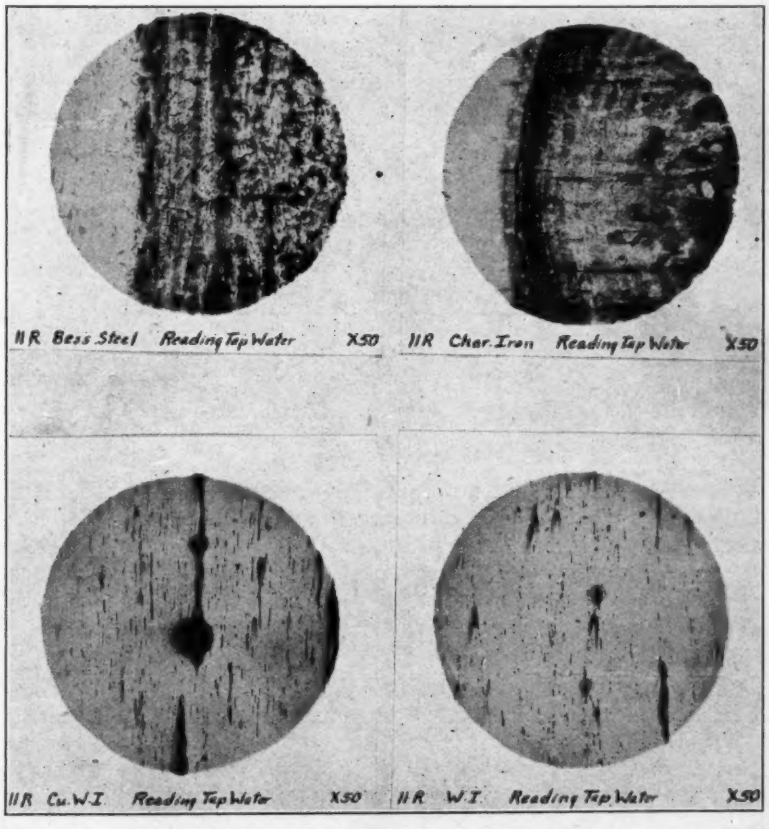
Figs. 5 to 8 show specimens immersed in Schuylkill River water, high in sulfides and containing 3.9 parts per million of carbon dioxide and 11.2 parts per million of dissolved oxygen.

Figs. 9 to 12 show specimens tested in City of Reading tap water, which normally contains 1.7 parts per million of carbon dioxide and 9.9 parts per million of dissolved oxygen.

A very convenient form of test specimen is a ½ in. tube of the metal to be tested, polished on one or more surfaces. The degree of polishing will affect the results. High polishing of the surface has been shown in some cases to result in inhibition of corrosion. A finish with number 0000 emery polishing paper gives a very satisfactory surface for most materials.

A corrosion tester has been developed which provides a simple and convenient means of exposing these test specimens to the fluids, either gases or liquids, in existing pressure vessels, while working under pressure or other normal operating conditions.

The tester is clearly shown in Figs. 13 and 14. A heat-treated cast aluminum yoke, and brass and aluminum stuffing box assembly form a guide and means for projecting a stainless steel spindle through a valve and connection into the desired point of application. Test specimens are carried on the end of the spindle. After the connecting nipple and valve are once installed, it is not necessary again to interrupt the normal operation in the test vessel. With the spindle fully withdrawn and the test specimens attached, the assembly is screwed into the valve, the valve opened and the specimens projected into


11R Bess Steel Reading Tap Water X50
11R Char. Iron Reading Tap Water X50
11R Cu.W.I. Reading Tap Water X50
11R W.I. Reading Tap Water X50

Figs. 9, 10, 11, 12—Test in City of Reading Water Drawn from the Tap. Carbon Dioxide Content, 1.7 p. p. m. and Dissolved Oxygen Content of 9.9 p. p. m.

the vessel, pipe lines, pumps, and distribution system.

Inspection of the specimens may be made as often as desired by removing the yoke assembly from the valve, which remains permanently in place as long as tests are to be made at that point. This makes it possible to carry on tests without interrupting pressure or other normal operating conditions in the vessel, pipe line, etc.

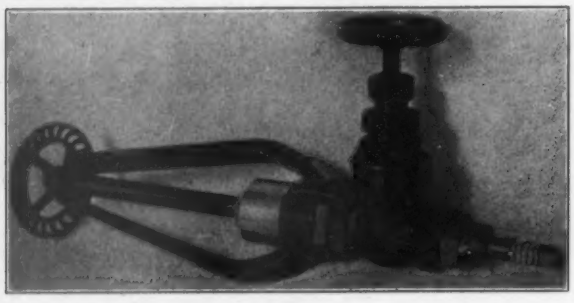


Fig. 14—Section Through the Corrosion Tester

The tester has been designed for use at pressures up to 400 lbs. A 200-lb. all brass valve is suitable for pressure up to that amount, and a 400-lb. Monel metal valve for pressure above 200 lbs. per sq. ft. Valves of other materials and for other intermediate pressures may be used if they are available in suitable style. All other parts of the tester are standard and interchangeable for use with either valve.

Some operators may prefer to use other methods of test. The tester is adapted to other methods and can accommodate other forms of specimens. For instance, a fine wire specimen having relative light weight compared to the surface area exposed is especially adapted to tests employing the determination of loss of weight per unit area of surface exposed. Likewise a number of specimens cut from thin sheet-metal may be used with proper insulating arrangements when employing the loss of weight method of evaluating corrosion intensities.

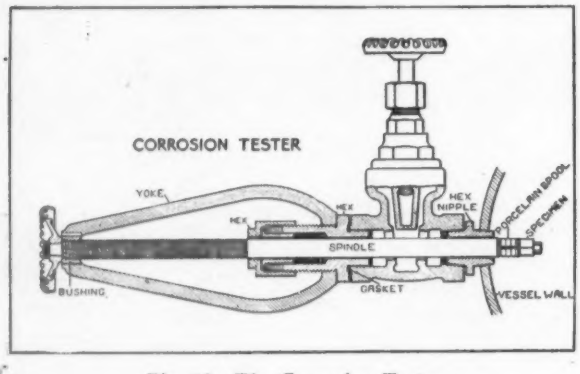


Fig. 13—The Corrosion Tester

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THE FIRST WATER SUPPLY OF ST. PAUL, MINN.—The first plant which supplied water to the city of St. Paul, Minn., was built by the St. Paul Water Co., a private organization, in the fall of 1869, which company operated under a state charter granted in 1857. The source of the first water supply was Lake Phalen, from which the water flowed by gravity through a 16-in. cement pipe and a 24-in. glazed earthenware pipe.

Technical Committee of the R. F. C. Completed

President Hoover has just made public his appointments to the Special Technical Committee which will advise the officials of the Reconstruction Finance Corporation concerning the feasibility or eligibility of construction projects, for which funds are requested under the provisions in Section 201 of the Emergency Relief and Construction Act, passed as the Wagner-Garner Bill.

This Committee is that referred to in the Act as the Control Projects Board and the immediate development of a national organization with engineering representatives located at strategic points throughout the country will follow.

The Committee is headed by Charles D. Marx, revered Professor Emeritus of Civil Engineering at Leland Stanford University and a Past President and Honorary Member of the American Society of Civil Engineers—referred to by all who have studied under him, known him intimately, or sought his advice, as "Daddy" Marx.

THE COMMITTEE

Charles David Marx, Chairman; Past President and Honorary Member A. S. C. E., Professor Emeritus of Civil Engineering, Leland Stanford University, Palo Alto, California.

John Herbert Gregory, Director, A. S. C. E. for Virginia and Maryland, Member N. E. W. W. A., A. W. W. A., Professor of Civil Engineering, John Hopkins University, Baltimore, Md.

Herbert George Moulton, Member A. S. C. E., 20 Pine St., New York.

John Lyle Harrington, Member A. S. C. E., Consulting Engineering, Harrington & Cortelyou, Kansas City, Missouri.

Major General Lytle Brown, Member A. S. C. E., Chief of Engineers U. S. Army, ex-officio member.

John S. Coleman, Past President, A. S. C. E., New Orleans, La.

This group of Engineers will decide the merits of applications requesting money to be loaned for construction of self-liquidating projects, including Water Works and Sewerage.

▼

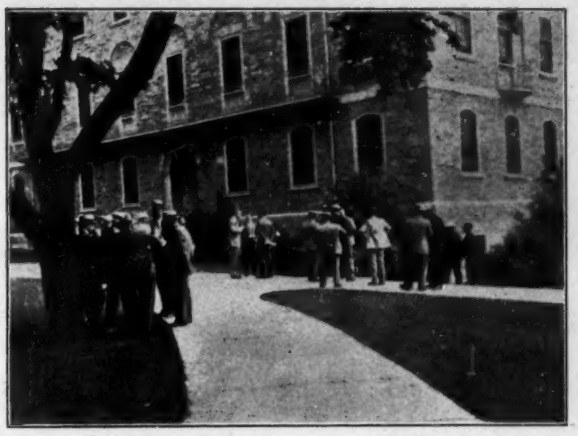
F. J. O'Donnell, Indianapolis Water Company, Wins Prize

The first prize offered for the best title of a picture in the June issue of "The Dump Truck on the Job," published and distributed gratis by the St. Paul Hydraulic Hoist Company of St. Paul, Minn., was won by J. F. O'Donnell of the Indianapolis Water Company. Mr. O'Donnell is somewhat of an artist also and gave the picture, showing a man fishing with his right arm around a pretty girl, the winning title—*"Using the Right Hook."*

▼

ESTIMATING GROUND WATER SUPPLIES.—The U. S. Geological survey has recently published Water Supply Paper No. 638-C, "Outline of Methods for Estimating Ground-Water Supplies," by Oscar E. Meinzer. This paper discussed rock formations as reservoirs and conduits and describes methods for determining intake and discharge. Copies may be obtained for 10 cts. each from the Superintendent of Documents, Washington, D. C.

CONFERENCE PENNSYLVANIA SEWAGE WORKS ASSOCIATION



"On the Campus." Between Sessions of the Sewage Works Conference at Pennsylvania State College.

THE Sixth Annual Conference of the Pennsylvania Sewage Works Association was held on June 23rd and 24th immediately following the Conference of the Pennsylvania Water Works Operators' Association* at State College, Pa. The registration was something over 100.

The annual banquet held at the Nittany Lion Inn was presided over by H. E. Moses, of the State Department of Health, who introduced speakers and conducted the "Question Box" and Round Table Discussion for which the Pennsylvania Conferences are reputed. Among the guests introduced was a visitor from England, J. T. Calvert, who had just made a tour of inspection of Water and Sewage Works in America after having completed his graduate studies in Sanitary Engineering at the Massachusetts Institute of Technology. Mr. Calvert is returning to England and for the immediate future will probably be connected with the Ministry of Health, which his father has for many years served as Chief Chemist.

Outstanding papers read in the Technical Sessions were those by Geo. W. Jones, of the U. S. Bureau of Mines, who spoke on "Explosion Hazards of Gas from Sewage Sludge Digestion" and other dangers such as gas poisoning and asphyxiation. Isaac S. Walker, Consulting Engineer, of Philadelphia, Pa., read a highly stimulating and thought provoking paper on "Functions of Sewage Treatment Works." Both papers created considerable discussion—that pertaining to Mr. Walker's paper being carried over for continuation following the banquet. E. S. Chase of Boston, Mass., gave the conference the benefit of excellent moving pictures which he had taken of European sewage treatment works during a recent trip abroad and made explanatory remarks concerning European sewage treatment practice.

Resolutions and New Officers

Resolutions were passed, expressing the appreciation of the conference for the enjoyable meeting and perfection of arrangements by members of the faculty of State College of Pennsylvania and the efforts of the Engineering Division of the State Department of Health which had made such conferences possible. A vote of appreciation was given L. D. Matter, Secretary of the association and other officers who had been responsible for the successful meeting.

The question of merging the Pennsylvania Sewage Works Association with the Water Works' Operators' Association was discussed and thereafter referred to the executive committee for their consideration. Because of increasing expense in connection with holding meetings, it was voted that hereafter in addition to annual dues a registration fee of $1.00 be charged those attending the conferences as had been already voted by the Water Operators' Association.

New officers elected are:

President—Prof. R. O'Donnell, State College, Pa.
Vice-President—Harry Krum, Allentown, Pa.
Vice-President—R. L. Phillips, Meadville, Pa.
Secy.-Treasurer—L. D. Matter, Wilkes-Barre, Pa.
Editor—J. R. Hoffert, Harrisburg, Pa.

C. A. Emerson, Jr., and H. E. Moses were elected as members of the Board of Control of the Federation of Sewage Works' Associations.

Technical Sessions

President Monroe introduced Professor R. L. Sackett, Dean of Engineering at State College, who rapidly reviewed the progress made in sewage treatment to date and concluded his remarks with a word of welcome from State College to the Conference members.

The following papers were presented:

"Activated Sludge Practice," by Philip B. Streander, Consulting Engineer, Philadelphia, Pa.

In the author's absence his paper was presented by H. M. Feeburn. Mr. Streander reviewed progress made with the activated sludge process of sewage treatment, its strong and weak features and discussed the mechanism of the process, such as various methods of securing agglomeration of the diffused solids and subsequent oxidation of the soluble and colloidal organic matter. He particularly dwelt on the "air lift channel" development in aeration units wherein the diffuser tubes are located behind baffle walls and near the surface of the liquid level in the tanks. The advantage was a reduced air requirement, only 3 lbs. air pressure being needed to produce the necessary cross-tank travel of sewage to produce effective oxidation. He believed that only about 10 per cent of the oxygen requirement came from the compressed air (lift) and the remainder from contact of sewage with the air during its repeated travel across the tanks. He referred also to the Link Belt aerator which was entirely mechanical but gave a surface velocity of 2.5 ft. per second linear travel across the tanks at the surface. Further reference was made to economy of the Dorr scheme of using submerged paddles with a small volume of diffused air admitted below the paddles. He said that return of some of the activated sludge to the crude sewage entering primary settling tanks had improved operation of plants to a noticeable extent.

In discussing power requirement for aeration he had found the following to hold in general:

*Reported elsewhere in this issue.

L. S. Morgan, District Engineer State Department of Health, Pittsburgh, Pa., Retiring President of the Association.

Spiral Flow (diffused air), 30 to 40 H.P. per m.g.

Shallow Suspended Air Diffusers, 29 H.P. per m.g.

Simplex Aerators (revolving turbine), 18 to 20 H.P. per m.g.

Submerged Paddle Wheels with diffused air, 15 to 18 H.P. per m.g.

For primary clarification tanks (crude sewage) a flow through of about 700 gals. per sq. ft. of tank surface per day was approved practice, providing 1 to 1½ hour theoretical retention period. For final clarification tanks (activated sludge) 1½ to 2 hours retention period was required and provision for 1 sq. ft. surface area for each 800 to 1,200 gallons of flow per day.

Mr. Streander spoke of the "off days" which activated sludge plants experienced and the necessity of too frequent by-passing of sewage in order to correct the upset conditions of the process. He felt the process too costly for most small installations and too difficult to maintain on an even keel. He had found highly skilled operators essential in connection with the process and felt the costs of operations must be reduced if the process was to continue in favor.

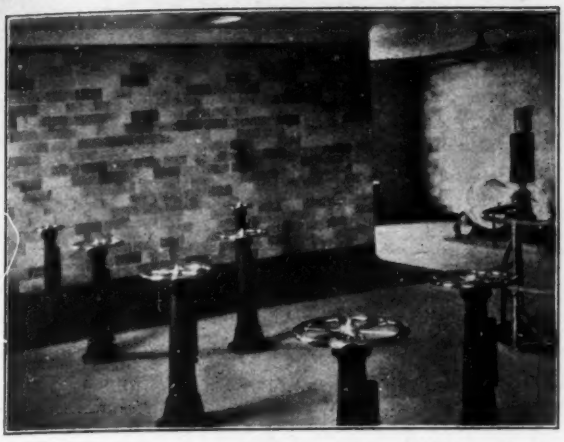
W. Donaldson, of Fuller and McClintock, Engineers, considered Mr. Streander had given an accurate picture of the situation but thought that the power requirements would be more nearly 25 H.P. per m.g. using 0.5 cu. ft. air per gallon as the low limit. Aside from costs, the problem at activated sludge plants is the capacity of tanks required for sludge digestion. At the Hagerstown, Md., plant they were planning to do away with digestion and employ direct vacuum filtration of the fresh sludges such as was being planned elsewhere also. Mr. Donaldson referred to the perforated copper tubing used for air diffusion at the new Morristown, N. J., plant and the London, Ont., practice of large sludge reaeration tanks and the relatively short aeration period given the sewage-sludge mixture. The reaerated sludge could, when necessary, be drawn on heavily to correct an upset condition in the aeration tanks. He had not found the degree of clarification to be dependent upon sludge quality but the performance of the final settling tanks would be less perfect with sludge of light gravity. He agreed that they had much to learn about the process and particularly how to control the "weeds" that get a foot-hold in the sludge from time to time. The marked variation in quantities and quality of sewage reaching small works rendered the activated sludge process costly and of doubtful practical value for other than the larger municipalities.

"Explosions and Health Hazards Caused by Gases from Sewage Sludge Digestion," by Geo. W. Jones, Chemist, U. S. Bureau Standards, Pittsburgh, Pa.

Mr. Jones, in a highly interesting and instructive paper presented known facts concerning the explosibility of combustible gases and "fogs" of naphtha, etc. Demonstrations were given to prove that under optimum conditions it was not always essential that heat sufficient to give a visible glow be applied to ignite certain vapors. Other demonstrations of explosion of varying degrees of severity resulted from air-gas mixtures in varying proportion. The same applied to the travel of flame in an enclosed place such as a digestion tank or barrel of a sewer. The flame would travel to a point at which the oxygen supply would become optimum and there an explosion would occur. Generally, he said, increased pressure would lower the ignition temperature of gases. Sludge digestion gas would ordinarily ignite at a temperature of 500 to 600° C. and hydrogen sulphide, another gas generated at sewage plants, ignites at a lower temperature (346 to 379° C.). A mixture of the two would ignite at some intermediate temperature. Flames in ignited gas-air mixture may travel as fast as 10,000 ft. per second or at a slower rate, all depending upon circumstances. Gas from sludge will not explode until the air to gas ratio falls with definite limits, viz., a mixture containing between 5.3 and 16 per cent gas. At increased pressures, however, a mixture containing considerably more gas will be flamable or explosive, but the more violent explosions take place at the lower gas concentrations.

In speaking of the health hazards, Mr. Jones said, that hydrogen sulphide ranked along with the fatal hydrocyanic acid gas in deadly effects. At 50 parts in one million of air, irritation and nervousness is caused; between 600 and 800 parts per million (.06 to .08 per cent) acute poisoning results; and at 0.1 per cent (1,000 p.p.m.) paralysis, heart failure and death occur in rapid succession. Lower concentrations are detected by the bad odor but the lethal concentrations destroy sense of smell and are thereby the more dangerous. Carbon-dioxide gas, according to Mr. Jones, is much more hazardous than is ordinarily appreciated. An atmosphere containing 5 to 6 per cent of the gas will produce headache and 7 to 10 per cent may prove fatal. The existence of any gas which causes an oxygen deficiency by lowering the content in normal air is dangerous. Air contains about 20 per cent oxygen and lowering this to 10 per cent by the presence of methane, sewer-gas or sludge gas creates a decidedly dangerous atmosphere. Exposure to sludge gas without air would cause the collapse of a man within a few minutes and death would follow if not promptly resuscitated. When oxygen content drops as low as 8 per cent the face will become leaden color and a drop to 6 per cent results in loss of the use of limbs. Mr. Jones then named certain approved instruments used to detect the presence or the approximate concentrations of combustible gases in sewers, sumps, pits, mines and

Dr. Rudolph "Checks Up" on Harry Freeburn and Says He's "O. K."



Pottstown's (Pa.) New Sewage Treatment Plant. (Note Chromium Plated Trimmings)

the like. Among these were the F. M. indicator, the Mine Safety Appliance Company's detector and the Leeds & Northrup indicating recording instruments.

John R. Downes, Superintendent, Sewage Treatment, Bound Brook, N. J., said that it was evident that in the light of the newer hazards of sewage plant operation, more common sense in operating and a better appreciation of hazards in design were necessary. To his question **Mr. Jones** replied that sludge gas would diffuse rather uniformly with any air admitted to a tank in a short time. Examining man holes to which gas had been admitted disclosed this phenomena. When a flame traveled down or up a sewer or through a tank, the pressure ahead of it would increase markedly. In reply to question from Dr. Rudolfs, he replied that the presence of hydrogen sulphide would lower the ignition temperature of methane or sludge gas.

H. M. Beaumont, Engineer, Bureau Sewers, Philadelphia, Pa., told of experience of giddiness during inspection of a new sewer traversing marsh land. Mr. Jones remarked, that gases from marshy land contained as much as 30 per cent carbon dioxide which would not have an odor but would actually be lethal. He thought that the use of blowers to force air into manholes or tanks was a very practical way of rendering them safe to enter.

C. C. Agar, of the New York State Department of Health, referred to hydrogen sulphide detection by exposure of a silver coin or lead acetate papers which would darken due to reaction with the sulphur in the gas. The rapidity of darkening would reveal the extent of the presence of the gas. He wished to direct attention to an editorial on the hydrogen sulphide problem which appeared in Water Works & Sewage, June, 1932.

Mr. Jones was given a vote of appreciation for having put before the conference in such an interesting manner the facts concerning explosion and health hazards. Later during the meeting a resolution was passed requesting the officers of the association to prevail upon The U. S. Bureau of Mines to continue studies with sewer and sludge gases in order to assist designing engineers and operators in preventing accidents at sewage treatment plants.

"The Function of Sewage Treatment Units," by Isaac S. Walker, Consulting Engineer, Philadelphia, Pa.

Perhaps the best paper written on the prevailing practices and policies involved in sewage treatment which has appeared in years was that presented by Mr. Walker. The keynote of his remarks was that sewage treatment should be carried as far as would be required to make full use of the valuable dilution afforded in the water-way receiving the effluent and *only* that far. He felt that in too many instances sewage treatment works had been too elaborately designed and the extent of treatment had exceeded that required when it came to evaluating the ability of the receiving waters to assimilate the effluent without producing health hazards or nuisances.

In taking up the various units in sewage treatment plants he felt that other than coarse screens ahead of settling tanks were a waste of money and effort. At Ipswich, England, he had seen coarse screenings shredded and returned to the inflowing sewage for settling along with the other solids in the tanks. At Moscow, Russia, the screenings from 1-inch bar screens had been ground up and returned to the crude sewage with success at a 40 m.g.d. plant since 1914. In that way screenings and sludge went the same route. In grit removal, he felt that the mechanical equipment (detritors) now used was very valuable in rendering a satisfactory grit and he spoke of the successful use of diffused air aeration to remove grease from sewage. He then dealt with settling tanks and what they would accomplish, i. e., removing the most objectionable parts of the sewage. Per dollar invested in structure or spent on operation settling tanks returned a measure of value in excess of any other unit in the plant.

In referring to oxidation units he felt that much "cussed" and discussed trickling filter to be still the most dependable and satisfactory oxidizing device known and believed it was here to stay. Rotary distributors for filters he thought had not been given the credit deserved; they were less odor producing and gave the most efficient distribution with a minimum of head required. Now, with chlorination for relief of bed ponding and for odor control, filters were more practical than ever. Flooding seemed to cope with the fly nuisance and with chlorine available in large containers the cost had been reduced to a point where it could be more freely used than heretofore.

In connection with sprinkling filters, he had been impressed with what he had seen of pre-aeration of the settled sewage for a period of thirty minutes to one hour. He spoke of the 15 m.g.d. experimental plant at Moscow, Russia, applying 30 gal./cu. ft.

Isaac S. Walker, Consulting Engineer, Philadelphia, Pa.

L. D. Matter, District Engineer, State Department of Health, Wilkes-Barre, Pa., Secretary-Treasurer of the Association

media (about 4 times the customary rates) to filters which had been made possible because of the pre-aeration given the sewage. Other cities had demonstrated that a similar increase in loading could be given filters by using the same procedure. It appeared to be economical and practical.

Concerning the activated sludge process, he said, that it had fallen short of earlier expectations and that industrial-waste and certain domestic wastes in the sewage would interfere with it too often to consider the process an entire success. The skilled supervision required, the cost of operation and its delicate constitution were against it. Functioning as an intermediate stage ahead of filters, however, it had proven meritorious at Birmingham, England, Moscow, Russia, and elsewhere. With 0.1 cu. ft. air per gallon and 30 minute aeration followed by 1 hour sedimentation at Moscow, the solids removal had averaged 50 per cent. The floccular suspended matter which passes to the filters does not seem to do harm even at the high rates of application (30 gals./cu. ft.) of sewage applied.

In sludge handling and digestion he felt that a combination of Imhoff style tank with separate units built to digest and store the sludge or scum taken from the former might work out very economically. With the demand for heat, light and power at sewage plants, more consideration must be given to power development from the sludge gas. For sludge drying he felt a combination of open and glass covered areas should work out most economically and practically. Metering of water by municipalities should be encouraged to reduce sewage flow. That would reduce treatment and pumping plant costs and operating charges.

He felt that sedimentation supplemented when necessary by seasonal chlorination to further reduce oxygen demand and protect health might be all that should be necessary in the way of treatment in certain instances where heretofore oxidizing units had been necessitated.

Dr. W. Rudolfs, Director New Jersey Sewage Substation, New Brunswick, N. J., in discussing Mr. Walker's paper said that he considered its contents very stimulating and agreed that in a number of instances unnecessarily elaborate plants have been built, costing far too much for the treatment given or required. He thought that when complete treatment is required, settling pre-aeration, trickling filters the depth of those at Moscow (12 ft. deep) and final settling tanks would cost as much or more for construction and operation than would an activated sludge plant. He was in agreement that Imhoff tanks built large enough had a number of advantages in small plants over other types. Metering of water did reduce consumption and consequently sewage flow, but that appeared to be of temporary duration only, if one could judge from records available.

The question was raised by Dr. Rudolfs concerning what stream flow would be considered in his (Mr. Walker's) proposal to provide less costly or less complete treatment and what about protecting water supplies? This question led into rather debatable discussion which ended with a request that Mr. Hoffert of the State Health Department offer an "opinion." Mr. Hoffert said that each problem was one to itself. Mr. Walker closed by saying that chlorination of the sewage should be used whenever water supply was involved and that in providing sewage treatment "the cloth would have to be cut to fit the suit," but he thought there would be instances where chlorine might be used to advantage to reduce oxygen demand and substitute for oxidizing devices during periods of low stream flow. There would be instances where that might not prove adequate and more elaborate treatment would be required. It offered a good opportunity for an interesting study of the economics of disposal practice.

Chemical Precipitation Discussed

In the "Question Box" there was one in particular which created considerable interest and that was assigned E. S. Chase of Metcalf & Eddy, Engineers, to answer. The question was, **"What may be accomplished through chemical precipitation treatment such as is involved in the Laughlin process employed at Dearborn?"** Mr. Chase referred to past experiences with the lime iron process at Worcester, Providence and elsewhere. He said that 80 to 90 per cent of the organic matter might be removed and a somewhat less high removal of the B.O.D. value would result. He thought the magnetite filter idea quite novel and interesting. At the present the plant at Dearborn was not handling the flows for which it was designed.

H. M. Freeburn, of the State Department of Health, asked Mr. Chase if he was not rather high in his figures of organic matter removal. To this Mr. Chase replied that the figures were not far out of line, if any, because the Worcester plant had given in its early life some astonishingly high removals.

W. Donaldson, of Fuller & McClintock, Engineers, New York, was called upon for an opinion. He spoke favorably of the so-called Dearborn or Laughlin process and commented on the effluent secured from the experimental Laughlin plant at Coney Island. He referred to the lesser chemical dosages involved in the present modification of the precipitation process when compared to the requirements in earlier plants where coagulation was less efficient, sludge handling difficult and no straining of effluent was involved. He thought it well worth watching. In reply to a question Mr. Donaldson said that the B.O.D. of the effluent before chlorination had run around 30 parts per million, which compared with 15 parts residual B.O.D. in the final effluent after chlorination.

F. W. Jones, formerly associated with George Gascoigne, Consulting Engineer, and more recently the City of Cleveland, warned against accepting the Dearborn process until it had been amply demonstrated. His idea was that chemical precipitation gave misleading results, but if it had merits time would tell.

Another timely question from the "Question Box" was:

"What is the sludge gas consumption per Horse Power developed in gas engines?"

M. B. Tark of the Link-Belt Company was requested to reply. Mr. Tark said, that producer gas engines require 14,000 B.t.u. per brake h.p., which meant 14 to 20 cu. ft. of sludge or natural gas (700 B.t.u.) per h.p. hour. He suggested the slow speed type engine (200 to 300 r.p.m.) such as was manufactured by the Fairbanks-Morse Company and others.

Sludge Digestion

"Sludge Digestion Experiences at Baltimore," by Edward Cromwell, Principal Sanitary Chemist, Baltimore, Md., Sewage Treatment Works.

Mr. Cromwell described the cumbersome procedure of dewatering and transfer of sludge and scum from

C. B. Tygert, State Engineer, Wallace & Tiernan Co.

Frank B. Attemus, Superintendent Sewage Treatment Works, Norristown, Pa.

the plain settling tanks to the digestion tanks at Baltimore. They had averaged 0.25 cu. yds. of fresh solids (90 per cent water content) per capita per year. the pH value at the time of transfer was extraordinarily low, viz., 4.8 to 5.2. In the routine transfer 10 per cent fresh solids by volume was added to one or more tanks every fourth day. The Summer temperature in the digestors would run around 68° to 70° F and 4.4 cu. yds. of digested sludge (90 per cent water) had been the average drawn to the sand beds or lagoons for each million gallons of sewage treated. Drying time of the sludge had been as short as 10 days but more usually several weeks had been required for proper drying. The depth put on a bed was that required to produce a cake 4 inches thick with 75 per cent moisture content. Demand for sludge by farmers and others had increased until now the production was only about half the demand.

Future plans at the Baltimore plant would entail heated sludge digestors and dewatering of digested sludge on vacuum filters which was now being carefully studied by operating experimental dewatering units and using ferric coagulants for sludge conditioning.

In discussion **R. R. Cleland** of the State College, Sewage Treatment Works, commented on their difficulties with slow sludge drying on open sand beds. It was apparent that the sludge had been poorly digested, but **E. S. Chase** gave the conference the benefit of his experience with applications of chlorinated lime to choked beds. As a result the dewatering rate had been markedly improved. The application had been about 50 lbs. to each 1,000 sq. ft. of sand bed area.

John R. Downes of Bound Brook, N. J., said that the addition of a coagulant to digested or partially digested sludge as it was being drawn to the beds had increased the rates of dewatering markedly. The gas produced from the reaction between the bicarbonates and the coagulant had floated the sludge and allowed rapid seepage of liquor through the sand.

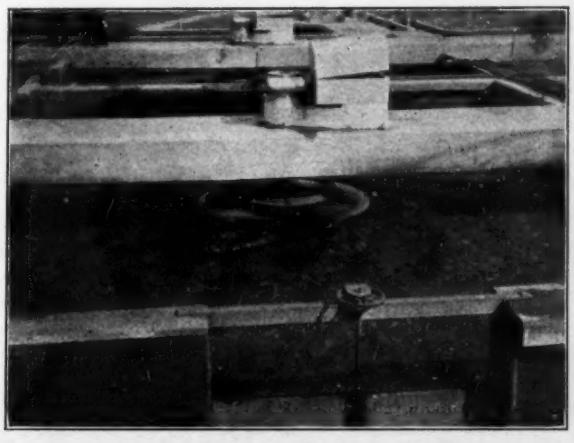
"Design and Preliminary Operating Results at the Erie (Pa.) Sewage Treatment Works," by A. B. Cameron, Superintendent Sewage Treatment Works, Erie, Pa.

Mr. Cameron's paper dealt with difficulties experienced in operating the new Sewage Treatment Works at Erie, Pa., and the means of overcoming or correcting such difficulties. These in fact had been all minor rather than major ones. The new plant had been in operation since October, 1931, and was just now in first-class operating shape. Sedimentation and separate sludge digestion constitutes the treatment provided. The effluent (20 m.g.d.) is discharged through an outfall sewer 11,000 feet long into Lake Erie.

Interestingly enough, said Mr. Cameron, no bypass around the plant or any single unit had been provided. One of the earliest improvements had been the installation of a bypass which he considered the most essential unit in almost every sewage treatment works. Mechanically cleaned bar screens with ¾-in. opening between bars had proven impractical and alternate bars had to be cut out. The incinerator for burning screenings, supposed to have a capacity of ten tons per day, had to be considerably changed to reach the designed capacity. Better draining of the screenings had to be provided which had reduced the cost of incineration by one-half. A loss of water content to the extent of 30 per cent or better of the weight of screenings was being secured in 4 hours' drainage. The ash production had been 12.6 per cent of the volume of screenings burned.

The Dorr grit detritors had been very satisfactory, but due to the fact that about 50 per cent of the material removed is grain from illicit distilling operation, it is now proposed to incinerate rather than bury it. About 0.4 cu. ft. of grit, plus other materials, per m.g. sewage flow had been removed. The clarifiers had yielded a sludge of 92 per cent moisture content which is pumped 6 times daily for a total period of about 5 hours of slow pumping. Skimmings from the surface of the clarifiers had been mostly grease amounting to about 0.3 cu. ft. per m.g., which had been incinerated with the screenings. In passing through the clarifiers the B.O.D. value of the sewage had been reduced 35 per cent and settleable solids by 89 per cent.

Digestor performance had been very satisfactory. During the first 90 days 25 tons of lime had been added to these units and none had been needed since to maintain the desired pH value of 6.8. At present the sludge temperature is maintained around 70° F., but will be increased to 80° F. The sludge drawn has contained 9 to 13 per cent solids and 43 to 50 per cent volatile matter on the dry basis. On the beds it dries rapidly. The digestors are equipped with mechanical stirring devices. The sludge storage tank will be operated without stirring because tests have indicated a thicker sludge can thus be secured. Gas production has reached 0.6 cu. ft. per capita, a total of 75,000 cu. ft. per day, which, however, con-



One of the "Simplex" Aerator Units at Hatsboro's (Pa.) New Sewage Treatment Works

tains a high percentage (33 per cent) of carbon dioxide. Variable rates of gas generation, and resulting changing pressures on the system indicates the desirability of providing gas storage in the form of a pressure tank or gasometer to overcome this difficulty. Sludge is at present being taken from the drying beds by "sludge pickers" who peddle the material around town.

At this time operating cost data is not in shape for presentation, but even with sludge removal at no cost to the city, with the $20,000 budget set up for operation (17c per capita per year) it will be impossible to keep within that figure. The total cost of changes made at the plant to correct difficulties had been but 0.2 per cent of the cost of the works and that he considered very minor. The major expense had been in revamping the incinerator and changing the bar screen and its mechanism.

Le Basquet Puts Out a Long One

Hal Hutton Taking a Nice Stance

J. T. Campbell, of J. N. Chester Engineers, Pittsburgh, Pa., said that his firm had designed and supervised construction of the Erie plant. They had learned that coarse bar screens, having 4 or 5 inch clear openings, should be placed ahead of mechanically cleaned bar screens. He referred to the 2.5 mile outfall line from the plant into Lake Erie, terminating in upward flow multiple outlets which had been constructed at a cost of $650,000,000 in order that the shore waters and water works intake might be protected.

In reply to questions, **Mr. Cameron** said that the incinerator was a Midwest Company unit having 5 sq. ft. burning grate area and 25 sq. ft. total grate area. As revamped it had 5 burners; used 65,000 cu. ft. of sludge gas for its 10 ton per day capacity. The minimum temperature in the combustion chamber must not drop below 1,400° F. and they maintained 1,700° F. or thereabouts. Even after draining 4 hours in wire baskets the screenings contained 80 to 85 per cent moisture when charged into the incinerator.

"What the State Department of Health Requires of Sewage Works Operators," by L. S. Morgan, Engineer, Pennsylvania State Department of Health, Pittsburgh, Pa.

Mr. Morgan outlined many operating guides useful to sewage works operators. He mentioned the bulletin issued by the New York State Health Department—"Operation and Control of Sewage Treatment Plants"—as a very valuable guide. He stressed and cited the value of plant records and the desirability of getting advice from experienced engineers whenever necessary. The minimum tests which should be run at every plant was settleable solids, (Imhoff Cone), stability test using methylene-blue, the pH of sludge and residual chlorine determinations. He stressed the necessity of educating the taxpayers and interesting them to the point where operating funds would not be so difficult to secure. Pennsylvania had no sewer rental law and for that reason the necessary funds for plant operation were procured with difficulty. He felt that this association should sponsor a sewer rental law similar to those of several other states which placed sewage treatment on a self-supporting basis.

H. M. Freeburn made a motion that President Morgan appoint the necessary committee to study existing rental laws and frame a bill for Pennsylvania. The motion carried.

Plant Operator's Symposium

"How to Start a New Sewage Plant," by H. M. Beaumont, Philadelphia, Pa.

Mr. Beaumont said that a properly qualified operator was the first essential in starting a new treatment plant; valves and lines should be thoroughly tested by pumping through water; tanks should be filled also for testing. The operator should be qualified to direct labor, and to specify or purchase supplies. He said that settling tanks should be operated to provide 2 to 3 hours' detention period at the most, if odors and increased B.O.D. were to be avoided during the passage of the sewage through them. Where possible new digestion tanks or Imhoff tanks should be held out of service to be started in the Spring and thus avoid accumulation of undigested and acid sludge during the Winter. He warned against open flames and explosion hazard and said that all safeguards, such as ventilation and gas masks should be provided at chlorinating stations and frequent check tests made to detect small chlorine leaks.

Mr. Cameron added that a well equipped tool room and work shop was the greatest asset that any plant could have.

Mr. Beaumont referred to difficulties caused by oil or grease emptied into sewers. It was a nuisance and, furthermore, constituted a hazard in sewers and at the treatment works. They had been successful in keeping out most of the oil but automobile crank case drainings continued a nuisance.

L. H. Enslow called attention to a method developed by W. S. Stanley at Houston, Tex., for tracing the source of oil entering sewers. It consisted of wooden blocks painted white and numbered. These were distributed in manholes at various points on the system, being held by a cord fastened to the side of the manhole. Systematic examination of the white blocks would disclose oil staining and by such surveys the oil could be traced up the trunk sewers and branches to the offending establishment. The blocks merely floated on the surface of the sewage and the procedure had been a most effective method of spotting offenders. Mr. Enslow also pointed out the availability of oil traps which when full of oil would not pass drainage until cleaned out.

"Insect Control"—by W. J. Simpson, Supervisor of Sewage Plants, Reading, Pa.

In referring to the sprinkling filter fly nuisance, Mr. Simpson said that mixtures of 3 parts kerosene and 1 part orthodichlor-benzine had been effective when sprayed around the plant weekly for killing the adult flies. Flooding of filters swept the fly larvae

out of the beds and was thus the best available remedy. Improved clarification of the applied sewage had reduced organic deposits on the stones and fly breeding had been less noticeable as a result.

W. A. Ryan, Consulting Chemist, Rochester, N. Y., said that Pyrethum extract dissolved in kerosene oil was also a highly effective spray. Application of chlorinated lime to the filter surface had been the most effective scheme used where flooding could not be had. It had served him well and had been used effectively elsewhere.

Prof. C. L. Walker, of State College, referred to a filter that had been tightly closed over the top. Flies had not bred to any extent in the unit and oxidation had improved. The absence of sunlight had controlled the algae growth on the stone. He felt that the distribution of the sprays had something to do with the fly nuisance and traveling distributors should be helpful.

C. C. Agar—said that glass covers over filters had been helpful. The high temperature (140°F) produced seemed to kill the adult fly.

Dr. Rudolfs reported that fly breeding under the glass covers at Haddonfield, N. J., had been found.

L. H. Enslow—reported on fly nuisance produced at several plants which had wooden covers over the filters and thought the suggestion of improved clarification of the sewage to be the best that had been advanced. The flies always were thickest around filters on which the most solids had been deposited. The traveling distributor seemed to reduce the fly nuisance and where used very little if any fly nuisance existed provided the units had not been excessively overloaded with suspended matter depositions. It was highly probable that chemical or mechanical precipitation ahead of overloaded filters would eliminate fly nuisance and by reducing the oxygen demand make it possible for the unit to handle several times the accepted loading in gallons per day if not actual pounds of oxygen demand value. The traveling distributor had several advantages.

"Winter Operation"—by R. R. Cleland, Engineer, Sewage Treatment Works, State College, Pa.

Mr. Cleland presented difficulties experienced in operation of the State College sewage treatment plant in Winter. One Winter the exposed filter underdrains had frozen and ponding on the surface was intensified every Winter. He believed covering of small filters would be a help. In Winter the sludge while frozen could be readily removed from the drying beds and with less sand loss than in Summer. Sludge in early Spring dewatered very slowly and alum had been applied in the ratio of 6 lbs. to each cu. yd. drawn to assist dewatering. It was fed to the sludge en route to the beds. Removal of scum from gas-vents had been simplified when it froze and could be chopped out in chunks.

L. H. Enslow remarked that the freezing of the scum in gas-vents might be had at any period of the year by dropping "dry-ice" in them. Perhaps that was a "patentable idea" but if it facilitated scum removal or handling he would glady assign it to "public usage."

Isaac Walker referred to the successful use of chlorine at several plants for elimination of ponding on filters. The filters had not been hurt and chlorine costs had been reasonable—as low as $45.00 per acre for large works, to $100.00 for the smallest.

F. W. Jones said that filter performance at Cleveland had improved in Winter. He believed it due to better grease and solids separation in the settling tanks. Chlorine used at Cleveland had cost but $1.87 per hundred pounds and they could afford to use considerable when necessary. At other points it would be higher.

"Odor Control"—by W. A. Ryan, Consulting Chemist, Rochester, N. Y.

Mr. Ryan, formerly Chemist in Charge of treatment plants at Rochester, discussed the source and control of odors emanating from sewage treatment works. He stressed the need of cleanliness and good housekeeping. Hydrogen sulphide had proven the worse offender and its production could be stopped or reduced as desired by chlorination of the crude sewage. It was the best and least expensive "first aid" in odor control that had appeared. There were instances where glass covers for tanks and sludge beds would prove feasible also. Chlorinated lime sprinkled on stone and sand filters would destroy the surface odors and open the filters.

E. M. Slocum, said that the odorous materials in sewage could be destroyed by oxidation which produced saturated compounds from unsaturated ones.

M. B. Tark, remarked that proper thought given to the design of sewers and pump wells to prevent septic action and accumulation of solids, the use of variable speed motors or pumps to avoid long detention of sewage between pumpings and operating care would do considerable toward prevention of odors.

"Laboratory Control"—by M. J. Blew, Philadelphia, Pa.

Mr. Blew in discussing the importance of various determinations in the laboratory control of plant operation, had found that in sludge digestion the pH value should be taken on the supernatant liquor rather than on sludge samples and, furthermore, the total alkalinity was more important than the pH value in sludge digestion. As long as a total alkalinity between 1800 and 2000 p.p.m. was present in the liquor, digestion would proceed satisfactorily irrespective of the pH value. He believed that occasionally a 24-hour sampling at various points through plants, to determine hourly performance of the units, would reveal a great deal to the operator or superintendent. Since sewage treatment is becoming more and more a chemical engineering operation the laboratory was increasingly important.

W. A. Ryan, said that he had been impressed with the improvement in operation of sewage plants since the operators had taken courses at the Short Schools being held for operators in New York and New Jersey.

Following an open discussion of the advantages of the operators' license law, a motion was passed requesting the Executive Committee to study the problem of operator licensing and draft a bill for legislative considerations. Another motion was added, that the matter of establishing annual short courses for operators at State College be also given consideration by College authorities and by the Executive Committee. The meeting then adjourned.

**Para-dichlor Benzene is the product used now extensively in combating moths that destroy woolens. The ortho-dichlor benzene is the liquid remaining when the solid para-dichlor benzene is manufactured.*—ED.

Fig. 1—Slow Sand Filter, Farmington, Conn., During Reconstruction

WATER SUPPLY IMPROVEMENTS AT FARMINGTON, CONN.

By GEORGE H. BUCK

With Nicholas S. Hill, Jr., Consulting Engineers, New York City

SMALL water companies with limited earnings present a perplexing problem to the engineer called in to correct operating difficulties. Expenditures, not resulting in increased earning capacity, place an extra burden on the company. If they are large, the earning capacity of the company may be insufficient to allow the improvements to be made, no matter how desirable they may be. The engineer cannot temporize where the quality of a public water supply is involved, but it is often possible to exercise ingenuity and produce the desired results at a cost within the capacity of the company.

The Farmington Water Company for years has experienced difficulty in producing a satisfactory water and, in 1930, had a comprehensive investigation made with the object of improving the quality and determining future policy in regard to additional supply. As a result extensive improvements were made during the spring and summer of 1931.

The company is small. It serves about 1400 persons in the Borough of Farmington, a residential community west of Hartford, Conn. The operating force is limited to a part-time superintendent. The gross revenues amount to but $11,000 a year. Without an excessive increase in rates, large capital expenditures were out of the question.

The source of supply is the Wadsworth Reservoir located on a small stream, ¾ mile from the center of the town. About 80 per cent of the 0.3 square mile of watershed is wooded, the remainder being planted in orchards. There are no habitations on the shed but it is traversed by roads and subject to chance pollution by hunters, workers in orchards and other transients.

The reservoir is formed by an earthen dam with concrete core wall, 620 ft. in length and a spillway 30 ft. long is located at one end. Its available capacity before improvements was 35 million gallons. The dam varied as much as 2 ft. in elevation and at places the core wall was exposed with a freeboard of only 0.2 ft. above the spillway crest. Due to pervious embankment and poor horizontal joints in the core wall, leakage through the dam amounted to about 40,000 gallons per day with the reservoir full, or almost 25 per cent of the minimum safe yield of the supply. This leakage maintained a swamp, in which algae growths were heavy, and eventually found its way into the clear well.

The treatment plant consisted of two slow sand filter beds with a total area of .24 acres. The beds were open basins excavated below natural grade with earthen embankments. They were constructed with tile underdrains embedded in broken stone, 8 in. of broken stone and 19 in. of sand. Under normal operation about 1.6 ft. of water was maintained over the sand. When the water level reached 1.8 ft. above the sand it overflowed the filters and drained into the clear well.

The filters discharged into an open ditch and flowed thence to a tile pipe leading to the clear well. The inlets and outlets of the filters were manually controlled by valves in accordance with the demand.

The clear well was an irregularly shaped pit with a capacity of 140,000 gallons, excavated 3 to 5 ft. below the ground surface. A frame roof, in poor condition, protected it from the action of sunlight. The sides were open below the roof and water overflowed the basin forming a swampy area adjacent and was in part wasted.

The water entering the clear well was composed of filtered water, leakage from the dam and ground and surface water from an area of 23 acres below the dam. As there was no way of diverting the unfiltered water from the clear well, the filters were operated so as to make up the deficiencies from the other sources. At the time of the investigations, 35 per cent of the water entering the well was unfiltered. This percentage was increased at times by overflow from the filters and during rainy weather by increased surface runoff.

With conditions such as these it was not surprising to find the water in the clear well inferior to the raw water in the reservoir. B. Coli were present in the clear well in 1 C. C. samples 19 per cent of the time, in 10 C. C. samples 39 per cent of the time, and that occurred continuously for periods of several months. While this evident pollution may have been harmless, it is obvious that the barriers against dangerous pollution were insufficient.

In addition to the Wadsworth Reservoir supply, the company had an emergency connection with the Hartford aqueduct leading from Nepaug Reservoir to the West Hartford filters. A small pumping station had been built there and although the connections were not complete and the station never had been used it could be placed in service in a short time.

A number of schemes for augmenting or replacing the existing supply were considered and compared on an economic basis. The estimates demonstrated that the Wadsworth Reservoir supply should be retained as the primary source. Its average yield was ample to meet the demands for many years, and it was found to be more economical to purchase water from Hartford during periods of severe drought than to increase the safe

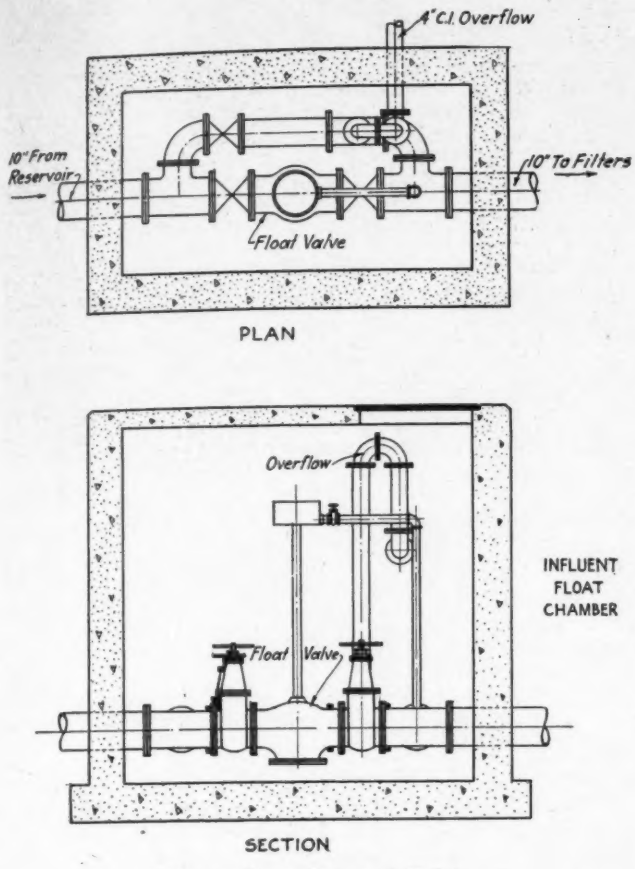


Fig. 2—Float Operated Valve

yield at the present time. This can be done in the future by increasing the storage and tributary watershed.

New construction to augment the supply therefore was limited. Needed repairs were made to the spillway and its crest was raised 12 in. Additional embankment and rip-rap were added to the earthen dam to give adequate height above the spillway and eliminate the danger of overtopping which previously existed.

Before deciding upon the improvements to be made to the treatment plant, the adequacy of the existing type of filtration was carefully considered. The raw water is low in color and turbidity and in general is one for which slow sand filtration is well adapted. Trouble has occasionally been experienced from clogging due to micro-organisms, the growth of which is promoted by the shallowness of the reservoir. This is an abnormal condition and can be guarded against, at small expense, by periodic microscopic examinations and the adoption of suitable measures to prevent excessive growths. Though the filters are uncovered, no difficulty has been experienced from the formation of ice nor has there been evidence of excessive growth of micro-organisms on the beds.

The substitution of mechanical filtration would have improved the quality somewhat but would have been attended by various objections. As the available head is limited pumping would have been required. It is practicable to design a pumping station and mechanical filtration plant of this size which can be operated successfully by a part-time superintendent, but in this instance the first cost would have been rather high and there is no doubt but that the payroll as well as the cost of current and chemicals would have been enhanced considerably.

The existing units were crude in construction but it would have been impossible to modernize them completely without practically rebuilding them and the expense of doing so seemed unwarranted considering the low rate at which they were operated, and the fact that the filtered water appeared to be satisfactory.

Reconstruction of the filters (Fig. 1) was decided upon with the object of improving and regulating their operation. The embankments were raised and paved so that a depth of 3 ft. of water could be maintained above the sand. The top sand was cleaned off and new sand added to bring the total depth to 20 in. A float operated valve (Fig. 2) was installed on the inlet line to maintain a constant level on the beds and prevent overflowing. Floating weir tubes (Fig. 3) were installed in manholes on the outlets to maintain filtration at a constant pre-determined rate, regardless of loss of head through the filters.

The old clear well offered little possibility of rehabilitation and it was obvious that an entirely new structure was required. As this was the only storage on the distribution system, a new concrete reservoir having a capacity of 200,000 gallons, with concrete roof and earth cover and embankments, was built. Water is brought into it from the filters by a cast iron pipe and all unfiltered water is excluded.

A gate house constructed as part of the filtered water reservoir contains a control valve to regulate the water level, the chlorinating equipment, and registering de-

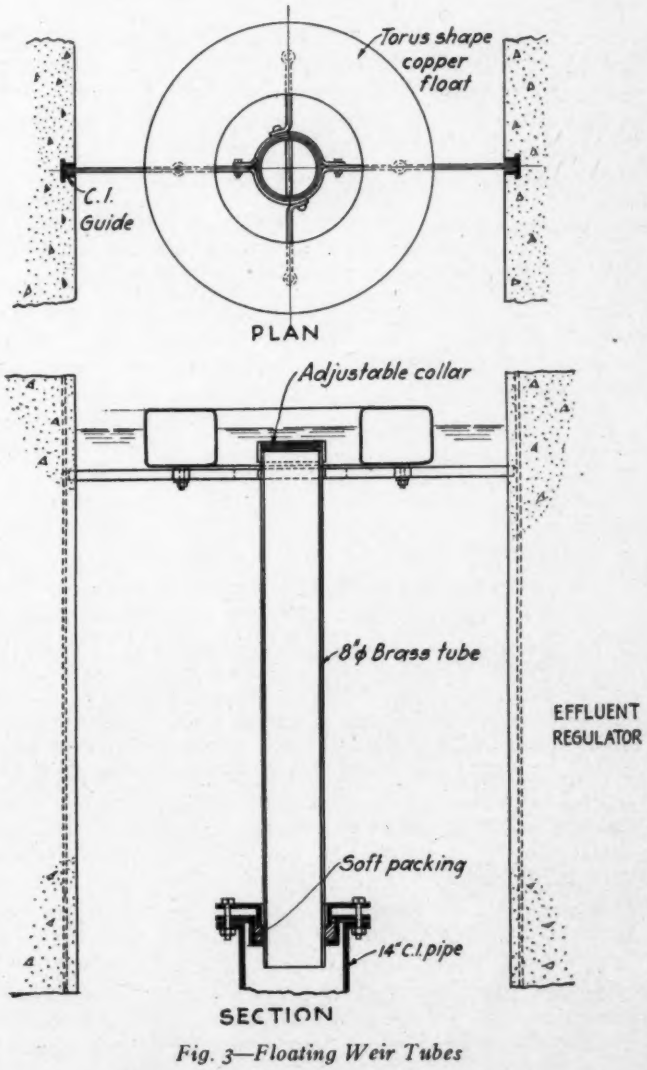


Fig. 3—Floating Weir Tubes

vices for a Venturi meter which was installed on the discharge line. Chlorine is added at the inlet to the filtered water reservoir and piping in the basin provides a period of mixing. The chlorine room was carefully insulated and is heated by electricity with thermostatic control.

During dry periods it is essential that the seepage from the dam, which represents a large proportion of the minimum yield, be utilized. Therefore it was collected and conveyed as before to the old clear well where two small self-contained automatically operated electric sump pumps were installed. When this water is required it is pumped back onto the filters.

These improvements, costing about $35,000, entirely eliminated the use of unfiltered water, conserved the seepage from the dam, measured and placed all operations under definite automatic control, added chlorination and did not add to the difficulties of operation. While the rate of filtration must be adjusted to daily and seasonal variations in use, utilization of the storage in the upper 18 in. of the reservoir is sufficient to allow filtration to be maintained at a uniform rate throughout the twenty-four hours. No difficulties have been encountered since the rehabilitated plant was put in service.

The investigations were made and the improvements carried out under the direction of Nicholas S. Hill, Jr., Consulting Engineer, 112 East 19th St., New York City. The contractor was C. W. Blakeslee & Sons, Inc., of New Haven, Conn.

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An Open Letter From A. S. C. E. Committee on Dams

To the Editor:—

We request you to print the attached "Open Letter" in your publications that it may be read by engineers in every country. We also request that you put a note to your publications asking "other editors please copy." It is through your assistance that we hope to reach engineers in all parts of the world.

Committee on Dams, Am. Soc. C. E.
H. de B. Parsons (for Committee).

To Engineers in All Parts of the World:

The Committee on Dams of the American Society of Civil Engineers is making a study of hydrostatic pressure both within and under the bases of dams. In this connection the committee invites the co-operation of engineers in every country who are designing or constructing dams.

The committee desires facts as noted by careful observation, and not opinions or theoretical discussions. Present knowledge regarding actual uplift under and within dams is limited. Therefore we ask engineers, when designing a dam, to incorporate in their plans methods of observing the hydrostatic pressures which will develop when the structure goes into service. All useful information that comes to the committee will be published for the benefit of the profession and full credit will be given to those who furnish reliable data.

Each engineer may design a method to measure uplift to suit his local conditions. The simplest installation for observing uplift is a system of pipes in which the pressure at the lower end may be measured by gauge or in a riser pipe. All pipes should be built into the dam as it is being constructed, with their lower ends open. For measuring hydrostatic uplift under the base, the pipes should terminate in suitably arranged cavities, filled with granular material, at the base of the structure. The pipes should be spaced at intervals along the length of the dam, and at each location there should be not less than three pipes in an up and down stream direction, this number increasing with the width of the base. If a rock foundation has extensive or nearly horizontal stratifications, other pipes should be carried down below the base to some of the rock joints. The locations and elevations below the base should be governed by the character of the foundation material, whether rock or soil, and the purpose should be to locate the pipes systematically in both longitudinal and transverse directions with the view to developing all possible conditions.

For measuring hydrostatic uplift within the structure, similar pipes should be arranged with their open lower ends at different elevations above the base, as the design of the structure will permit. It will be well to have their lower ends open into horizontal construction joints.

The pipes may be led to one or more central observing points as found convenient, so long as the grade is always upward. The size of the pipes is not important, but should be such as to permit observations of the water levels within them.

The cost of installing such pipes will be small when a dam is under construction, while the benefits to be derived may be very great. The public has a direct interest in the safety of dams.

We urgently request that the following procedure be carried out:

1. Observe the water level or water pressure in each pipe at intervals which should be practically simultaneous for each cross section, recording also the levels of the reservoir and tail water surfaces. The observation intervals should be frequent as the reservoir is filling. Thereafter every week or every month will suffice. At least a year's observations should be recorded.

2. Observe the temperature of the water, both in the reservoir and in the pipes. There is some evidence that uplift pressure may be affected by temperature.

3. Send us the observations at intervals. Also drawings of the dam showing the pipe locations, and necessary cross sections, all to scale. The drawings should illustrate the details of the cut off and the drainage system, if any, and show all other pertinent data. Also describe the character of concrete or masonry, and methods employed to secure bonding and to obstruct flow of water through the structure.

4. Send a detailed description of the foundation material, presenting all of its known characteristics, together with geological sections, both longitudinal and transverse showing joint systems, faults, bedding, etc. Photographs of the foundations also will be useful.

5. Repeat the observations asked for in paragraphs 1 and 2 sufficiently often so that seasonal variations will be disclosed. These repeated observations should be sent when made. Do not hold back the data asked for in 1, 2, 3 and 4, as its receipt may suggest the securing of other information that may be highly important.

6. Send all communications to H. de B. Parsons, 26 Beaver street, New York, U. S. A., who will acknowledge for the committee.

The committee would be glad to correspond regarding details should any one so desire.

Committee on Dams, Am. Soc. C. E.
Thaddeus Merriman, Chairman.

Frederick H. Fowler.	H. de B. Parsons
D. C. Henny.	Charles B. Wing.
J. B. Lippincott.	Silas H. Woodard

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Municipal Ice Plant Operations at Omaha, Neb.

The Metropolitan Utilities District of Omaha, Neb., of which Theodore A. Leisen is secretary and general manager, not only operates the water works, but also a gas plant and an ice plant. The following summary of the operations of the last mentioned, for 1931, are taken from a Public Service Bulletin of the district:

Character of Plant	Electric-Driven Ammonia Compression, Drop Pipe
Average Daily Capacity	200 Tons
Number of Ice Cans (400 lbs. Capacity)	2,400
Capacity of Daily Storage	500 Tons
Capacity of Long Storage	28,000 Tons
Cost of Plant, including Real Estate	$692,282.45
Total Sales in Tons	55,801
Total Cost per Ton of Ice Sold	$3,02
Income per Ton of Ice Sold	$3.93
Number of Jitney Stations	59

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State and Municipal Financing—During the first half of the year state and municipal public improvements were financed by bond issues aggregating $487,904,691, according to the record of *The Daily Bond Buyer* of New York.

EDITORIALS

The R. F. C. and Water Works and Sewerage

FROM the office of the Secretary of the American Water Works Association, within the past fortnight, went a letter to Water Works Managers and Superintendents in all American cities having populations of 50,000 or over. This letter set forth the conditions and stipulations under which municipalities and privately owned water works could borrow money for betterments from the Reconstruction Finance Corporation (R. F. C.), operating under the new Emergency Relief and Construction Act set forth in the recently passed Wagner-Garner bill. The message constituted a part of the work undertaken by the Association's Committee on Water Works Betterments to which outstanding men in the association have devoted much of their time and efforts to secure, in the wording of the Emergency Relief Act, a provision for ample aid to water works.

The Act provides $1,500,000,000 for loans to municipalities and corporations for projects which can be proved to be "self-liquidating," i. e., in the words of the Act—"that will be made self-supporting and financially solvent, and if the construction cost thereof will be returned within a reasonable period by means of tolls, fees, rents or other charges or by such other means (taxation excluded) as may be prescribed." Among the projects coming under that classification, privately or publicly owned water works are specifically mentioned in the bill.

The association's letter directs attention to the low rate of interest charged by the Government on approved loans through the R. F. C. and thereby the dual opportunity which municipalities, corporations and water works men now have to secure betterments to water works at low cost and at the same time assist in breaking the depression and serving the Nation in the present emergency. "Now," reads the letter, "it is time for those in charge of water works to play a major part in bringing the country out of a depression for which there is no longer an excuse—provide employment and stimulate trade recovery to the fullest extent contemplated in the passage of the Relief Act."

Sewerage, when self-supporting or when it can be made so, is accorded the same treatment by the Act as are water works. In order to borrow for water works improvements through the R. F. C., some municipalities may find it necessary to revise rate schedules in order to render the water works system self-supporting. Sewerage, being more frequently dependent upon funds from tax collections to cover construction and operating costs, will in numerous instances have to be financed from other sources. Those municipalities operating sewerage systems and treatment works in states where there exists a Sewer Rental Law can, if not already doing so, place their sewerage systems on a self-supporting basis, by making a service charge for the collection and disposal of sewage. Such a procedure, having already proven its merits where enforced, will automatically render the municipality an approved borrower of governmental funds for Sewerage betterments. Municipalities or other political subdivisions in Michigan, Ohio, Maryland and other states having Sewer Rental Laws already in force, are able to improve, construct and operate sewage works with the same facility as they can water works projects.

Those municipalities which cannot secure R. F. C. assistance expressly for sewerage betterments, can probably secure the needed funds from their states—each state having the right to borrow through the R. F. C. to the extent of $45,000,000 for direct relief.

Those who heed the letter of the American Water Works Association Officials will gain, and at the same time help others by helping themselves. The same holds true in connection with Sewerage.

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Chemical-Mechanical Sewage Treatment

CHEMICAL precipitation processes for purifying domestic and industrial sewages bid fair to return to favor. The past history of this type of treatment has not been in its favor, and for that matter it has not been more than a few years ago that separate sludge digestion was seemingly wrong and Imhoff tanks impossible. With the newer and better understanding of the functioning and control of sludge digestion and digestion tank operation and design, the digestion process no longer offers any particular difficulties.

With chemical precipitation of the old order, there was just as much wrong as there was in other processes of sewage treatment. With an advanced appreciation of the mechanism and control of coagulation, the relative merits of one chemical vs. another, the use of the hydrogen ion value in control, and, above all, the appreciation of the value of mechanical flocculating devices, chemical precipitation in the purification of water and treatment of industrial wastes and sewages is placed on a different basis than was formerly the case. At least a smattering of science has been mixed into the art.

Recent published articles and the discussion, praise or "reserved opinion" concerning the process which has been heard lately at meetings of Sewage Works Associations, is indicative that a renewed interest has been awakened in the possibilities of *modernized* chemical precipitation processes. It has at least one distinct advantage, in that it is a controllable process and is not subject to biological phenomena which too frequently suffer upset from "overloaded" sewage plant conditions or the arrival of "slugs" of some unexpected industrial waste. The process has another advantage—flexibility; furthermore it can be employed as the primary treatment to serve in precipitating and removing "overloads" or peak-loads of oxygen demanding materials from the sewage before it is sent to biological units. It thereby may serve well as an economical means of increasing capacities or efficiencies of existing biological plants. It is subject to seasonal usage and thereby the cost becomes just what may be necessary to meet effluent requirements, and no more.

When the workings of chemical-mechanical processes become better appreciated by those who have been accustomed to thinking in terms of biological treatment alone; when costs are compared on an annual basis,

including interest and depreciation along with operating costs; then chemical precipitation as an adjunct to other processes, if not the sole process, will receive the favorable consideration deserved.

L. H. Enslow

Cities Should Adopt the Harriman and Rockefeller Policies in Times of Depression

THE avalanche of protest against high taxes will soon sweep many an incompetent public servant out of a job, but many a useful servant will be swept out also. In the zeal for economy in public expenditures there will occur many parsimonious acts. Towns inadequately supplied with water are apt to remain so inadequately supplied that the next drought may result in a conflagration that the fire department cannot control. Cities that had planned extensive metering are apt to postpone the expenditure, and thus continue pumping a great volume of water that daily runs to waste. Municipalities that had planned to filter the water are apt to continue drinking mud-soup at intervals that are all too frequent, coincidently inviting a typhoid epidemic. Judging by the reports of the fire-insurance underwriters, few towns have service mains of adequate size in all sections. We urge readers to look up these reports with a view to using the data in them to convince public officials and citizens that certain waterworks improvements are urgent. At a time when both materials and labor are securable at the lowest price in eighteen years, there is not a single sound argument against bringing every water-works plant up to a good standard of economic efficiency.

During the depression of 1893-98 Harriman and his associates bought interest in two western railways. His first step was to put engineers to work to find out what should be done to secure economic efficiency. His next step was to raise the capital to make the line changes and buy the equipment needed to carry out their recommendations. Result: Harriman died worth $100,000,000. By making desirable improvements when prices are low, the citizens of every town in America can do for their water-works and sewerage plants, on a small scale, what Harriman did on a great scale for the Southern Pacific and the Union Pacific railways.

Don't forget to remind your townsmen that Harriman did not hesitate to borrow money, where necessary, to carry out his plan of securing highly economic instruments of transportation.

Rockefeller did the same thing in the oil business. He has been quoted as saying that one of the secrets of his success was that he increased his holdings and improved his plants during every great business depression. When competitors were retrenching Rockefeller was expanding. When competitors were wondering whether the oil business ever again would be profitable, Rockefeller was expending money to insure that at least *his* oil business would be profitable.

With such examples as Harriman and Rockefeller—were there no others—it should be possible to convince any city council, any daily paper editor, any intelligent taxpayer, that the present time is the ideal time to make those additions and improvements in water-works and sewer systems that are recommended by competent hydraulic engineers.

During a business depression operating expenses should be cut wherever it can be done without loss of efficiency. Capital expenditures should be increased at such times in order to reduce future operating expenses. This vital distinction is apt not to be appreciated by the general public. So it becomes your function as an engineer or as an operating official to do all in your power to make this distinction clear to the public.

How Water Works Superintendents Can Accelerate Water Works Improvement

THERE is probably not a water works in the world that is ideal from an economic viewpoint. On one or more streets the mains have been outgrown. Larger mains would reduce both pumping expense and fire risk; and a reduction in the fire risk would reduce insurance rates. A pump that once was the best on the market has become obsolete, and is wasting money every day. Universal metering would mean universal saving of fuel or electricity in the pumping station, but public objections born of ignorance have often halted the metering program. These are typical of the economic defects of many a water works.

A water works superintendent is well aware of many of the economic defects of his own plant. But unless he is a trained hydraulic engineer there are probably other economic defects that he has not seen, or, seeing, has not correctly evaluated. We need not tell such a superintendent that he owes it to the city to urge periodic studies of the water works by hydraulic engineers. But perhaps we should point out that at times of business depression there is the greatest need of economic studies by such experts.

A doctor should examine each of us once a year even when we are well, for "an ounce of prevention is worth a pound of cure." When we are ill we usually call a doctor. Nearly every taxpayer is economically ill. Engineers are economic doctors. Call them in.

Many a city has a city engineer who is a competent economic doctor. Ask him to study the economic defects of the water works. Since he is usually a "general practitioner" he may feel incompetent to complete the economic diagnosis of a water works, or to prescribe the economic treatment. Then he will advise seeking the services of a consulting hydraulic engineer.

Although a water works superintendent may have no engineering degree, it frequently happens that he has trained himself in the solution of many kinds of economic problems relating to water works. When this is the case, he should be competent to convince the public that certain improvements can be profitably undertaken. If so, it his duty to the taxpayers to present facts and figures that will convince them that those improvements should be begun at once. We say "at once," because this is undoubtedly the low point in the price curve, and because workers are exceptionally efficient when jobs are so scarce. Moreover, it is a duty that everyone of us owes to our idle fellow man to aid in bringing about his re-employment.

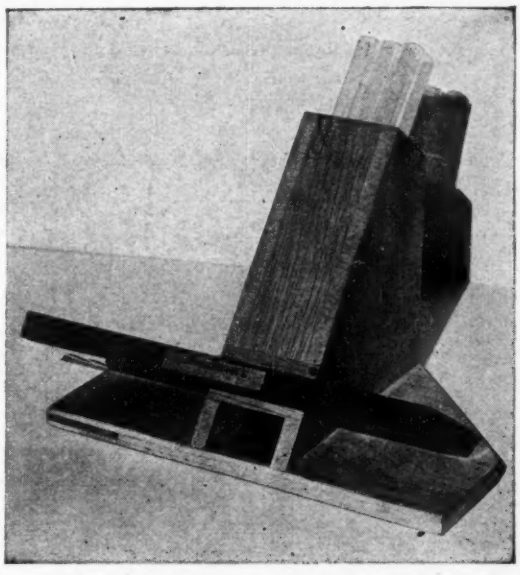
Grant that it may not have been your practice to promote any improvement project. Is this not the best of time to change that practice? Have you not the best of incentives to make such a change? You have an unexampled opportunity to bring about wise investments in water works improvements and enlargements. To the satisfaction of having accomplished this economic result will be added the satisfaction of having driven despair away from the home of many a worker, both in your own city and in the cities in which materials are manufactured.

H. P. Gillette

NEW EQUIPMENT AND MATERIALS

Taylor Water Analyzer

The Taylor Water Analyzer, which has just been placed on the market by W. A. Taylor & Co., Inc., 872 Linden Ave., Baltimore, Md., was designed first to greatly simplify the methods of water analysis and second to supply a set at a price attractive to even the smallest water works. Some of the disadvantages of making determinations by older methods have been the handling of cumbersome, fragile and expensive Nessler tube standards and the high cost of replacements caused by breakage of these standards. These difficulties and expense have been eliminated in the new Taylor Water Analyzer.



Taylor Water Analyzer

The set consists of two principal parts, the base and the slide. The base consists of a holder for the three Pyrex sample tubes. The holder is set at an angle of about 45° with the base and is divided into three compartments by means of metal partitions. A piece of etched glass is placed across the bottom of the compartments to support the tubes and also to secure diffused light and the elimination of shadows. A small mirror is placed in the bottom of the base directly under the three Pyrex tubes.

The color standards are contained in Bakelite slides similar to those used in the Taylor pH Slide Comparators. Each slide contains nine color standards which alternate with ampoules of distilled water. For example the manganese color standard slide contains standards representing 0.0, 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0 and 3.0 ppm of manganese. These values are shown on the upper side of the slide, directly above the individual standards, so that they can be easily read. The color standard slides fit in a slot between the Pyrex tubes and the mirror. Standard slides for color, nitrogen, nitrite, nitrate, chlorine, total iron and manganese are supplied, and work interchangeably on the base. Anyone or a combination may be purchased.

The determination of color may be used to illustrate the method of operation of the set. The base is placed in such a position that the upper ends of the Pyrex tubes are directed away from the observer toward a window or other source of daylight. Two of the tubes are filled to the mark with distilled water and are placed in the two outside compartments in the base. The third tube is filled to the mark with the water to be tested and is placed in the middle compartment. The color standard slide containing the nine standards for color is then placed in position in the slot in the base and moved from side to side until a color match is obtained. Readings are made by observing the colors from the three tubes which are reflected in the mirror in the form of discs. If the color of the middle tube exactly matches that of one of the standards the color of the water is read off directly from the value appearing on the slide above the standard with which the match is obtained. If, however, the color of the middle tube lies between those of the standards on each side of it the color is taken as that half way between the two. Thus if the color lies between those of the standards marked 20 and 30 the color is recorded as 25. The same manipulation serves for all other determinations and the operation is rapid and simple.

This set is completely described in "Modern pH and Chlorine Control"* a copy of which will be sent free by W. A. Taylor & Co. on request.

*See also the Taylor Company advertisement appearing elsewhere in this issue.—*The Publishers.*

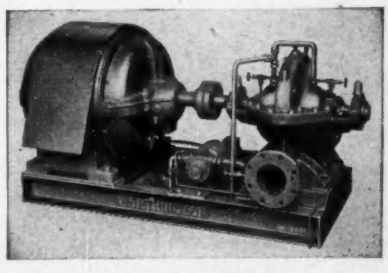
Worthington Develops New Automatically Primed Centrifugal Pumping Unit

Announcement has just been made by Worthington Pump and Machinery Corporation, Harrison, N. J. of a new self-contained automatically primed centrifugal pumping unit, having many distinct advantages.

The new unit comprises an electrically-driven high efficiency ball bearing centrifugal pump, mounted with its motor, on a fabricated steel bedplate, together with a Monobloc priming unit of the wet vacuum type, controlled by an electric pressure switch. The priming pump, or evacuator, is an adaption of the well-known "Hytor" pump, and is licensed to Worthington under patents of the Nash Engineering Company.

The evacuator is connected to the "high spot" of the suction volute by means of substantial tubing, and is sealed with clear water held in a reservoir built into the bedplate of the complete unit. The evacuator operates to remove air from the centrifugal pump, thereby causing it to be primed.

The evacuator motor is connected across the main pump motor line at a point between the starting switch and the motor, so that in starting the motor the evacuator motor also starts. The pressure switch is placed in the evacuator motor circuit and its pressure connection is piped to the discharge nozzle of the main pump. Whenever the discharge pressure of the main pump is below a pre-determined point the pressure switch is held in the closed position. When the discharge pressure comes up to normal the switch opens and remains open as long as the pressure is maintained. If the pump loses its prime the discharge pressure naturally drops. The pressure switch is thereby closed causing the evacuator to operate until the pressure is again built up to normal. A check valve in the evacuator suction line prevents air leakage from the evacuator to the main pump when the evacuator is not in operation.



New Automatically Primed Centrifugal Pumping Unit

By use of this arrangement it is no longer necessary to sacrifice efficiency and reliability for the convenience of self-priming. Since the evacuator motor is in

operation only when starting the unit or when it is necessary to reprime the main pump, no more power is used than with a non-printing unit. Likewise since the entire priming unit is compactly mounted on the bedplate between the main motor and the centrifugal pump, no more floor space or head room is required than with a non-printing unit. The entire arrangement is neat, simple, and soundly engineered for long life and low maintenance.

The use of these new units (now available with Worthington Type R, U, L and F centrifugal pumps up to the number six size, but shortly to be available with any type or size of Worthington centrifugal pump) makes possible effective remote control whenever suction lift exists, and eliminates costly and inaccessible wet and dry pit installations, and foot valves. It effectively prevents air binding, overcomes loss of suction and makes ejectors, priming tanks or hand primers unnecessary.

The special advantages claimed for this unit are:

1. The use of a modern, high efficiency, ball-bearing centrifugal pump.
2. No compromise necessary on the size and type of pump for a particular service.
3. A priming unit that operates only when needed.
4. The use of no more power and no more space than a non-priming unit.
5. Simple in construction, and positive and reliable in operation.
6. Longer life and lower maintenance cost than any other equipment designed to yield equal service.

Worthington motor-driven automatic priming centrifugal pumping units, as illustrated, are particularly adapted for water service or for sewerage or irrigation work, and will likewise be of special value to hotel and office buildings, as sump pumps.

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International Filter Company Offers Powdered Activated Carbon

"Hydrodarco" in pulverized form is now obtainable from International Filter Company of Chicago. For the past several years "Hydrodarco" has been marketed as a granular activated carbon for use in contact beds through which naturally clear waters or filtered waters have been passed, under pressure or by gravity, for the purpose of removing excess chlorine, color, tastes and odors. It has performed most efficiently in conjunction with chlorination and its use in pressure filter shells has been an effective means of removing tastes, odors, color, etc., from water employed in beverage bottling establishments, food producing plants, hotels, hospitals and the like. The largest municipal water treatment unit employing "Hydrodarco" has been that equipped at the Bay City, Michigan filter plant and units of less capacity have been installed at other municipal and industrial plants. It is just recently that International Filter Company have decided to offer this same carbon in finely powdered form to be applied in a manner similar to the application of other powdered carbons.

To feed "Hydrodarco" in powdered form, the company has developed the Infilco Carbon Feeder which is announced in their recent circular describing *"Powdered "Hydrodarco"* and the new feeder.

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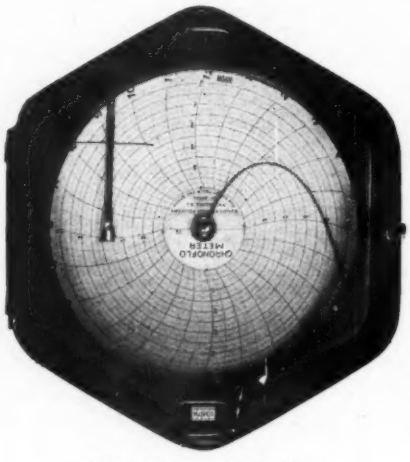
Builders' Iron Foundry Announces a New Meter

The new "Chronoflo" meter for liquids, announced by Builders' Iron Foundry of Providence, R. I., this month in their illustrated bulletin No. 261, has wide measuring range, accuracy and abundance of power. A chart record reliable to 1/12th the maximum rate and a total flow register accurate to 1/20th maximum flow is guaranteed. The "Chronoflo" instrument, which may be used with Venturi tube or orifice plate, utilizes four distinctive developments of modern research in its operation—the telechron motor, mercury switch, power relay and an electro-magnetic clutch.

A telechron driven contact device controlled by the height of a mercury column, which varies with the rates of flow through



The "Chronoflo" Meter.

the Venturi tube or orifice, and a telechron driven register-recorder continue in operation during the exact time that the mercury switch is "on" in the mercury unit. The switch is sensitive to minute changes in the mercury level in the indicating tube and the power relay instantaneously transmits the contact engaging the telechron drive with the integrating and recording movement through the electro-magnetic clutch. Thus the "Chronoflo" makes use of the remarkable accuracy of the telechron and thus the register-recorder can be located at any desirable distance from the pipe line and meter. For exceptionally long distances the public telephone system circuit can be used. Conversation is not interfered with.

The hexagonally-shaped case of the recording and registering instrument makes an especially pleasing appearance on a panel or the office wall. This instrument can be located at as many points as desired and its construction makes for ready access to working parts for inspection, adjustment or repair. The accuracy and wide range (20 to 1) of the "Chronoflo" will appeal to all who use meters on steam, air, gas, and liquids where wide seasonal, daily or hourly variations in the rate of flow is experienced. It will be especially valuable therefore, in connection with sewerage and sewage treatment works for measuring air on gas and sewage flows which have a marked variation during the 24 hours and rapid increases during storms. That also applies in connection with industrial water supply where variations in draught or pumpage are far more marked than in municipal water plants. Its convenience and accuracy will appeal to water works men. As indicated the name "Chronoflo" was coined to emphasize the principle used viz;—the measurement of flow *in terms of time* no matter whether the recording instrument be near the meter or far away; whether there be one or several instruments used. For illustrated details of this novel device the reader is referred to Bulletin No. 261 available upon request from Builders' Iron Foundry, Providence, R. I.

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Interesting Features of Monoloy Pipe

The American Cast Iron Pipe Company's announcement of the perfection of "Monoloy"—a high strength, light weight cast iron pipe which introduces the long-sought factor of permanence into piping for industrial and business buildings, is evoking considerable interest.

The high strength of "Monoloy" pipe in light weights is made possible by Acipco's method of centrifugal casting in sand-lined molds. This method also is responsible for its soft toughness—permitting it to be threaded, cut, drilled and tapped with ordinary pipe tools—and its advantageous bendability.

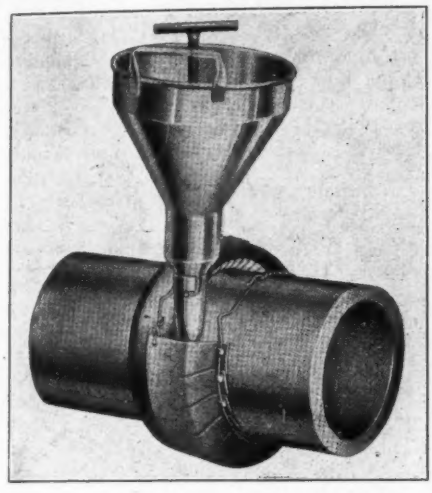
Monoloy Pipe is made to standard wrought iron and steel pipe O. D., in thickness approximating extra strong steel or wrought iron pipe. Standard Monoloy thicknesses are guaranteed for safe working pressure up to 250 pounds.

A wide range of diameters, lengths and joints is available. Diameters 1½ to 2½ inch, inclusive, are furnished in 5-foot lengths; diameters 3- to 12-inch are furnished in 16-foot lengths; longer lengths are available through the use of Acipco Cast Iron Fusion Welding at the foundry. Monoloy Pipe is furnished with plain ends, threaded ends, threaded ends with coupling, or the Monoloy Doublex Simplex Joint.

Although Monoloy Pipe is tough and strong, it is soft, permitting it to be threaded and cut with standard steel pipe stock and dies. This fact, plus the fact that Monoloy Pipe is made to standard steel and wrought iron pipe outside diameters, makes Monoloy Pipe a "good mixer." When old lines of a substitute material fail, one can replace them with Monoloy Pipe without disturbing the balance of the line.

Weston Sewer Pipe Joint Gasket, form and Filling Pump

Getting cement mortar evenly distributed all around *and to the bottom* of sewer pipe joints has been made simple by a development by L. A. Weston of Adams, Mass. Mr. Weston has perfected a "Gasket Form" used in placing cement mortar when jointing sewer pipe, even when the pipe is one-half submerged in the trench. The use of the "gasket" on the spigot end of the pipe within the bell insures an even space between bell and pipe for the mortar. The use of the "form" on the exterior makes it possible to secure water tight and root-proof joints that stay tight. The use of the Weston Filling Pump, shown as the funnel shaped instrument in the illustration, forces cement mortar com-



Weston Gasket and Form for Pipe Joints. View Shows Spigot End Entered in Bell with Form Wires Drawn up Tight

pletely around the pipe and completely fills the space between the interior gasket and the form on the outside. The "gasket" remains in place and the upper half of the joint is filled by hand in the usual manner. No jute or yarn is used in the jointing and ordinary workmen use the gasket and form without difficulty or the skill and care required when the job is done by hand. Inspection to insure careful jointing on the bottom of the pipe, which is necessary when done by hand, is avoided. For more detailed information request descriptive leaflets from L. A. Weston, Adams, Mass.

Coppus Safety Ventilator

The Coppus Engineering Corporation, of Worcester, Mass., announce a new and smaller size manhole ventilator in addition to their regular larger sized unit which has been so effectively employed for ventilating pits, sumps, tunnels and manholes in which men are at work. Both municipalities and industrial corporations have used this type ventilator with satisfaction for increasing man efficiency, eliminating hazard from gas poisoning or explosion and reducing waiting time for natural ventilation. Manholes are quickly cleared of dangerous gases within 5 minutes because of the high speed of the Coppus blower. Coppus ventilators are used by ship companies, the United States Navy and the Coast Guard to clear ship's holds and for clearing process tanks at manufacturing establishments.

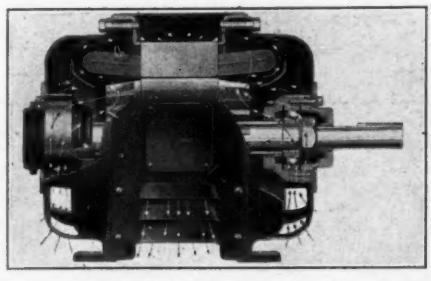
Equipped with a universal G. E. waterproof, ¼ h.p. motor, the blower operates

Coppus Manhole Ventilator.

from light sockets of 80 to 110 volts storage batteries carried by trucks. High efficiency produces a larger volume of air at less power consumption than any unit of similar size—the smaller size weighing but 74 lbs. is equipped with aluminum fan. The swivel joint permits directing the air current as needed through a 90 degree angle. The larger size is equipped with ½ h.p. motors and weighs 103 lbs. It can be supplied with a compressed air drive is preferred. Either unit is easily and quickly portable and is ready for plugging in for instant service. For use around sewage treatment works where gas pockets exist, presenting hazards to health and property, the Coppus portable manhole ventilator has a place among regular plant equipment. Write the Coppus Engineering Corporation, 344 Park Ave., Worcester, Mass., for descriptive Bulletin No. 163 which more fully describes this ventilator.

New General Electric Splash-proof Induction Motors

A new line of splash-proof induction motors has been announced by the General Electric Company. These motors are designed particularly for application in which



New G. E. Splash-Proof Induction Motor

open-motor operation is handicapped by the presence of splashing or dripping liquids.

The end shields are of special construction, the top half being solid to exclude dripping water and liquids. Cooling air enters through ventilating openings in the bottom half of the end shields, a special baffle, which extends to the center line of the motor shaft, preventing the entrance of splashing water into the windings.

The motor frame is protected against the entrance of dripping water and liquids by a one-piece cover, which is fitted to the motor frame. The ventilating air, which enters through the end shield openings, is circulated over the end windings, across the motor frame, and out through louvres in the protection cover. A watertight conduit box protects the motor leads against damage by dripping or splashing water.

Locations in which these splash-proof motors may be used advantageously include water works, and sewerage treatment plants, dairy plants, meat-packing plants, laundries, food, and process industries.

Semet-Solvay Aluminum Paint

The Semet-Solvay Co. have produced and now offer Semet-Solvay aluminum paint.

In developing this product ease of application, brilliant appearance, durability and a price as attractive as the resulting finish are combined in Semet-Solvay aluminum paint.

Alcoa Albron, the highest grade of aluminum powder, is used as the pigment portion of this paint. This pigment is made by stamping pure aluminum into tiny, thin flakes. As the paint is applied to any surface, with brush or spray gun, many of the tiny flakes of aluminum rise to the surface of the varnish vehicle, forming a leafed film—veritably a "Coat of Metal." To this characteristic Semet-Solvay aluminum paint owes its great light reflectivity, long durability, hiding power and resistance to moisture.

Semet-Solvay aluminum paint is sold in 1 and 5 gallon double-compartment cans, containing correct amounts of powder and vehicle. Just before painting, the trayful of powder is thoroughly stirred into the vehicle. The resultant paint is then ready for application by brush. For use in a spray gun, a small amount of linseed oil and drier should be added, to reduce the paint to proper consistency.

Semet-Solvay aluminum paint may be successfully applied over metal, wood, stone, brick, concrete or plaster. Used as a primer on wood, it seals the pores, preventing the penetration of moisture and subsequent blistering and peeling of the finished coat.

Address Semet-Solvay Co., 61 Broadway, New York, for literature and samples.

The Lubrotite Gate Valve

A gate valve having a unique duct system for introducing a lubricant-seal between the seating surfaces has been brought out by the Reading-Pratt & Cady Co., Inc., Bridgeport, Conn. It is stated that the valve is sealed tight even though the seating surfaces have become dam-

aged by scratches, deposits, or corrosion in the line. Among other advantages claimed for the valve are:

Seating surfaces protected by film of lubricant. They will not become corroded, scratched, or injured easily. Frees set wedge—lubricant-seal separates wedge from seats slightly freeing wedge that has become set from a long period of service.

The Lubrotite valves are made in both Pratt & Cady standard and extra heavy iron body patterns, and in Reading electric cast steel. The general dimensions are the same as the non-lubricated valves, so Lubrotite valves can be used for replacement service without changing the piping system in any way.

All valves seat absolutely tight without the use of the lubricant-seal and can be used, if desired, as regular non-lubricated valves.

Lubricant-seals are supplied for various services—air, gas, water, chemical, petroleum products, etc. The Lubricant-seals are packed in convenient pocket sized boxes—24 cartridges to a box. Only a small amount of lubricant is needed for an application.

▼

WITH THE MANUFACTURERS

R. N. Clarke Joins Innis, Speiden & Company

Robert N. Clarke has recently joined the staff of Innis, Speiden & Company, 117 Liberty Street, New York City for the purpose of developing uses and sales in the Sanitary Field of a concentrated coagulant—*Isco-Ferric Chloride* "66".

Mr. Clarke, a sanitary engineer, was graduated with a M.S. degree in Engineering from Syracuse University in 1925. He then served as Assistant Engineer under

R. N. Clarke

Glen D. Holmes at the Syracuse Sewage Treatment Works where he conducted a number of research studies in design and treatment of sewage, including the use of ferric-chloride as a coagulant. He has since done research work on water purification problems for the California Water Service Corporation. His immediately previous connection was as Sales Engineer, with King Construction Company, of North Tonawanda, N. Y. having charge of sales of glass enclosures for sewage treatment plants and sludge drying beds. Mr. Clarke, therefore, comes to Innis, Speiden & Company with a special knowledge of water and sewage treatment, and more particularly so in the matter of sludge dewatering and drying practices. He will introduce this new product of Innis, Speiden & Company into water and sewage treatment and is available to discuss the technical value of this supersaturated ferric-chloride coagulant, with interested Engineers and Municipal Officials.

Isco Ferric Chloride "66", contains 10 per cent more active coagulating material than does solid lump ferric-chloride but at the same time has the advantage of being a solution. It is supplied in non-returnable wooden barrels or can be delivered in tank cars such as are required by the larger sewage treatment works at Milwaukee, Chicago and elsewhere.

▼

H. B. Arrant Joins Industrial Chemical Sales Co.

H. B. Arrant, Professior at Simmons University, Abilene, Texas, is to join the forces, during the summer, of the Industrial Chemical Sales Co., Inc., 230 Park Ave., New York City, manufacturers of AQUE NUCHAR, in demonstration work for Texas, Louisiana, and Oklahoma.

Professor Arrant will visit all the Plants in that territory in the interest of Aqua Nuchar, showing methods of application, dosages, etc.

▼

Soft Water for the Whitehouse

In accordance with a regular policy of keeping the president of the United States and his family supplied with the most modern conveniences, the White House in Washington has been equipped with modern Zeolite water softening apparatus.

Ever since the White House was completed in 1800, the furnishing of healthful water to the nation's presidents and their families has been given careful consideration. The importance to the White House of water that is soft and clear, is apparent when it is known that the average daily consumption is about 90,000 gallons which includes all the water used in the White House the executive offices and in maintaining the grounds.

The water used by the early presidents up to the time of Jackson, was obtained from wells excavated on the White House grounds. The old pump and bucket were the only implements the early Presidents had available for obtaining their drinking water.

It was not until 1876 that the suitability of untreated Potomac water was officially questioned in a report made by Colonel C. E. Babcock, Corps of Engineers. Other similar reports were made in 1879, 1886, and 1898, and at last, in March 1901, Congress appropriated money for a slow sand filtration plant to make the water more healthful. The latest improvement has been the supplying of water of zero hardness through Zeolite softening units installed by the Permutit Company of New York City.

▼

Century of Progress Exposition Will Have Its Own Fire Protection System

The fire protection system for the Chicago Century of Progress Exposition will comprise three fully equipped fire stations with a group of pumping stations and automatic alarm system in the buildings and around the grounds. Water for the system will be drawn from Lake Michigan and the lagoon formed between the main land and the artificially constructed island along the lake front.

The Kennedy Valve Manufacturing Company of Elmira, New York has received an order for fire hydrants and valves going into this installation and the water supply system as well. About 150 "Safe-top" hydrants will be required. Over 250 gate and check valves will be used, ranging in size from 5 inch to 24 inch to serve under 150 pound working pressure. The fire hydrants will have 5¼ inch inlet valves, two 2½ inch hose connections and one pumper connection.

▼

Hydrauger Corporation Reorganized—New Offices Established

Thomas B. Whitted, President, The Hydrauger Corporation, 233 Broadway, New York City has just recently announced the formation of a new organization which has taken over the manufacture and sale of the "Hydrauger" earth-boring equipment, used in laying water pipes under pavement, embankments, buildings, sidewalks, etc.

It is the plan of the new organization to service the United States through district offices under the magement of engineers experienced in the work of "Hydrauger" equipment.

Other officers of the Hydrauger Corporation are H. V. R. Scheel, Vice-President and F. P. Palen, Treasurer, at 233 Broadway, New York City.

▼

Professor J. S. Whitener Associated with Industrial Chemical Sales

J. Summie Whitener, associate professor of sanitary engineering, North Carolina State College, Raleigh, N. C., is to join the forces, during the summer, of the Industrial Chemical Sales Company, Inc., manufacturers of Aqua Nuchar, in demonstration work for North Carolina, South Carolina and Tennessee.

Professor Whitener will visit all the plants in that territory in the interest of Aqua Nuchar, showing methods of application, dosages, etc.

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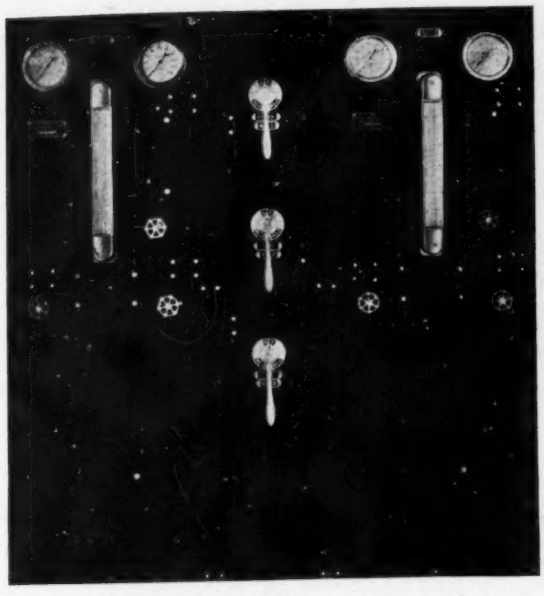
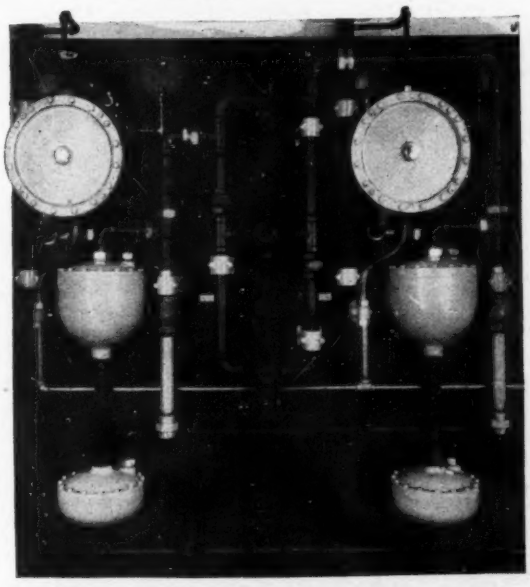


Twin 800# Panels at the Sewage Pumping Station Port Chester, N. Y.

One with 350 pound scale
One with 700 pound scale

Distributing Panel Between



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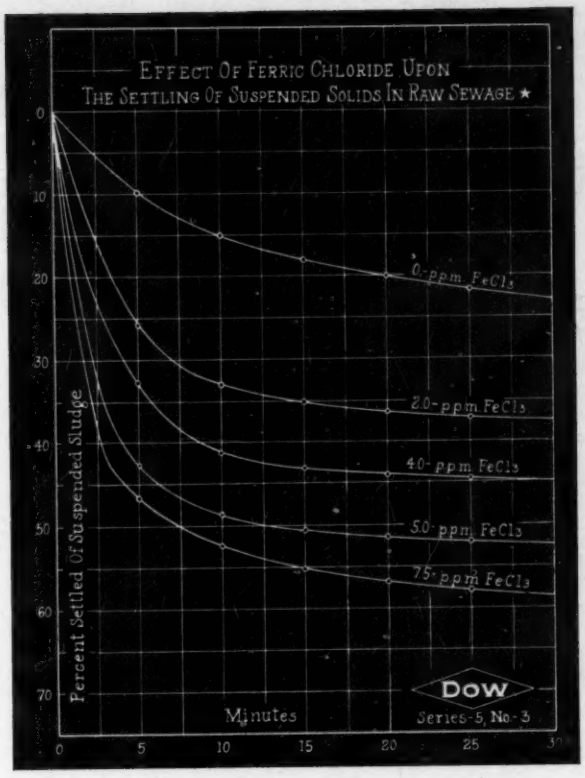

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Increases settling rate of Raw Sewage

The capacity of sedimentation tanks can be materially increased by the use of Ferric Chloride. The above graph shows the increase in the settling rate of raw sewage with the addition of various quantities of this coagulant. By adding a few parts of Ferric Chloride per million of raw sewage, the settling rate is increased fifty to sixty per cent. This means that the capacity of sedimentation tanks can be doubled when Ferric Chloride is used.

We would be glad to advise in the application of Dow Ferric Chloride Coagulant in your sewage disposal or water purification plant. Write for additional information and prices.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

*Rudolfs, Sewage Works, Jour. 1, 4 (399)

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RESEARCH AND CONTROL CHEMIST—B. S. in chemistry from eastern university. Three years' experience in industrial research on water treatment and boiler-plant control. Now associated with large research organization working on ammonia-chlorine process. Desire position as operating chemist or research development. Available immediately. Salary no consideration. Excellent references. Age 24. Are you keeping step with advances in water chemistry? Address "G. H. Y.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

MECHANICAL ENGINEER, experienced on design and construction of sewage plants and equipment. Has handled number of men on plant layout and design, including mechanical, electrical, structural, concrete, piping and machine design draftsmen. Recently supervised construction of mechanical-chemical sewage plant of Dearborn, Mich. Hard, conscientious, efficient, expert worker. Box 6006, Water Works and Sewerage, 420 Lexington Ave., New York City.

POSITIONS WANTED

This department has been started as a service to those in the Water Works and Sewerage Fields. We hope they will make use of it. The notices are inserted without charge.

CIVIL ENGINEER—Age 23; B. S. in Engineering, Princeton University, 1929; C. E., Princeton, 1932, with thesis in Water Supply. Over two years with American Bridge Company, Engineering Department, but very anxious for position in water supply or sewerage work. Experience desired primarily; remuneration a secondary consideration. Good draftsman. Excellent references. Address "D. E.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

EXPERIENCED DESIGNER on waterworks and sewerage. Have been with some of the country's leading sanitary engineering firms. Age 37. Married. Assoc. Mem. of American Society of Civil Engineers and Member of A. W. W. A. Have been in responsible charge of design. Box 6010, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

WATER CHEMIST AND BACTERIOLOGIST—Ph. B. in chemistry. Five years sanitary chemist, State Dept. of Health. Seven years in charge of purification and sanitation of large eastern water supply. References. Available immediately. Location immaterial. Married. Age 36. Box 6008, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

WATER WORKS SUPERINTENDENT—Three years' experience in charge of water works in city of 15,000 population. Prior experience: Eight years in charge of filtration plants in city of 100,000 population and one year in charge of sewage treatment works. Position desired as superintendent or assistant superintendent of water works, sewerage, or both. Age 36; married; American, and college graduate with C. E. degree. Immediately available. Address "W. W.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

EXPERT on sewage and industrial wastes disposal and stream pollution with ten years' experience and accumulated data. Formerly connected with largest disposal program in U. S. Qualified to investigate, study, report, design, supervise operation, construction, take charge or advise on all phases of sewage disposal. Permanent or temporary work desired. Box 6012, Water Works and Sewerage, 400 W. Madison St., Chicago, Ill.

SANITARY ENGINEER—27 years old; at present water works chemist in small town, three years water works and sewerage experience, B. S. and M. S. in Civil Engineering, desires change to large city or industry having domestic sewage and industrial wastes disposal problems. Modest salary to start, with increase as ability is shown. Address "A. B. U.," % Water Works and Sewerage, 420 Lexington Ave., New York City.

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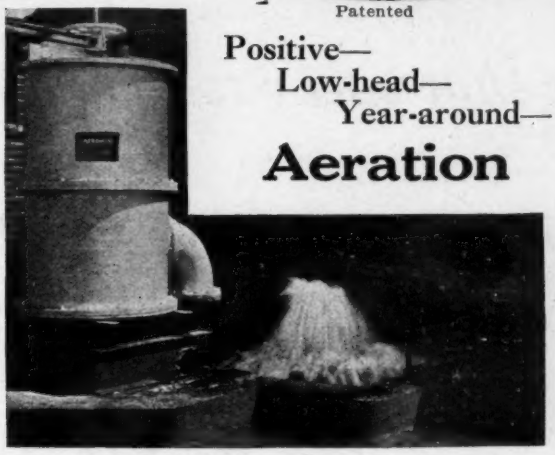

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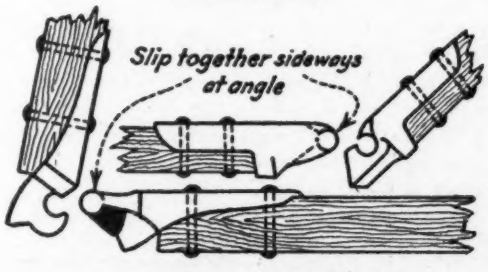

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—Excerpts from the Foreword

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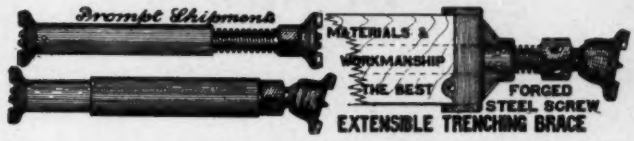

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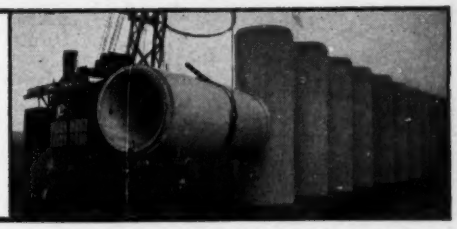

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WANTED

Copies of the May, 1931, and October, 1931, issues of Water Works and Sewerage are needed. Any subscriber supplying either of these issues will have his subscription extended for two months.

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Save Chemicals

•

Reduce Filter Washings

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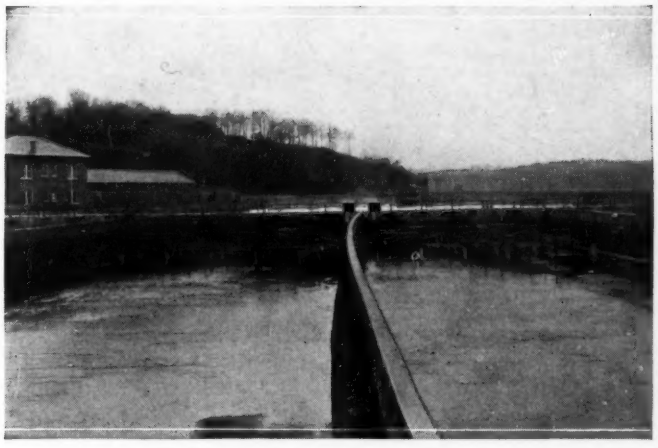
Improve Your Finished Water



DORRCO FLOCCULATORS offer every water plant using chemical dosing a chance to make savings *without any expense for new tank construction.* The Flocculators can be arranged to fit in existing tanks of any size or shape. You can use your present coagulation basins and actually increase their capacity after installing the Flocculators.

Dorrco Flocculators build up a quick-settling floc of uniform size. At one plant where sedimentation of the floc formerly spread over 700 ft., sedimentation is now complete 50 ft. after passing the Flocculators.

At the same time, chemical consumption has been reduced and a saving in cost of chemicals amounting to over *$15,000 a year* has been effected.

We would like an opportunity to demonstrate the savings that Dorrco Flocculators can make in your plant. Ask our nearest office about this demonstration or simply return the coupon at the right.

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The illustration above shows Dorrco Flocculators which were installed in the existing coagulation basins at Richmond, Va.

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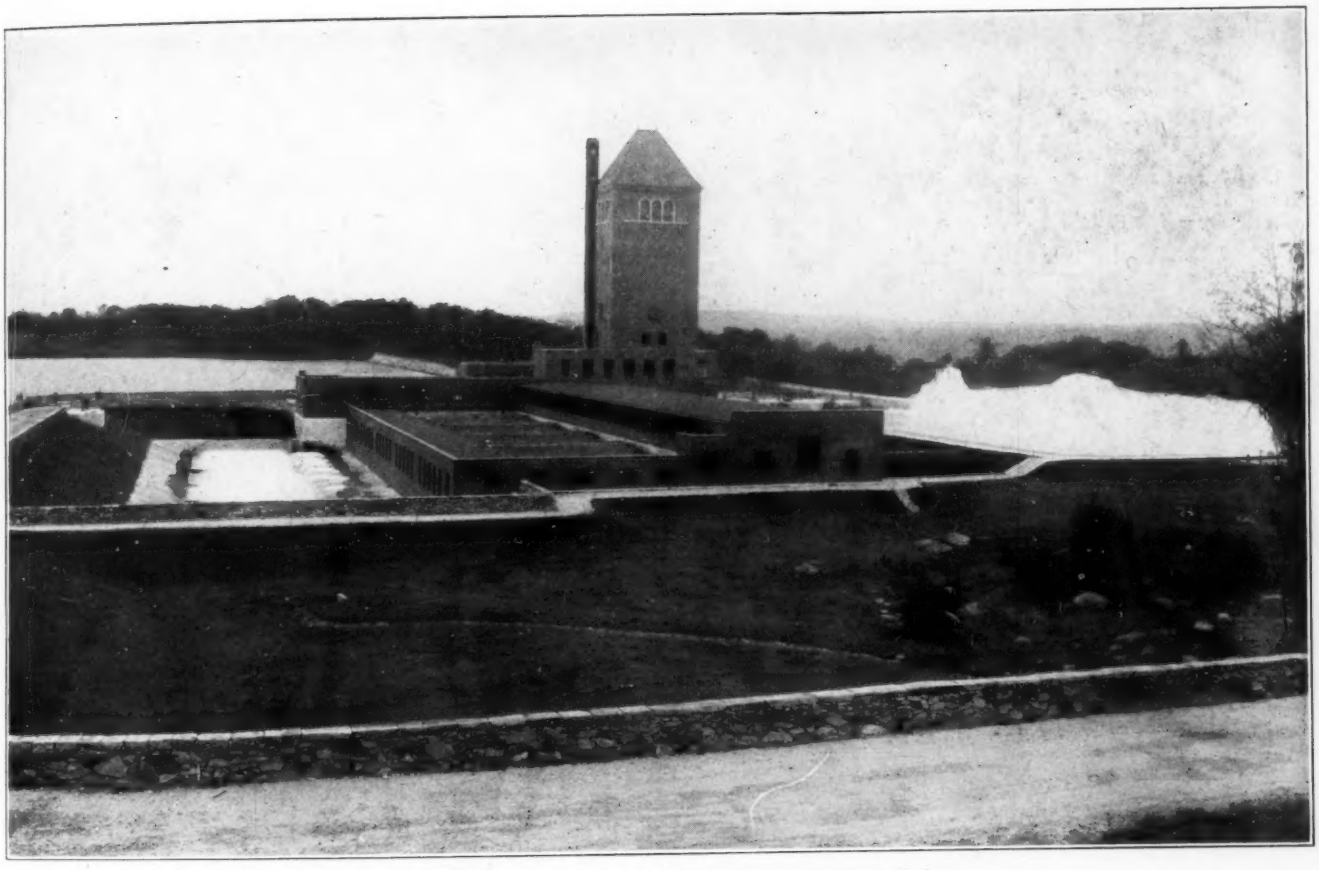

Water Purification Works—Providence, R. I. Raw Water Aerator at Right; Effluent Aerator at Left. Novel Design of Raw Water Aerator Pictured with Article Inside.

IN THIS ISSUE

Ferric Iron Coagulation of Soft Water

Specifications for Powdered Activated Carbon

Treatment of Cooling Water

Operating Results of Five Sewage Treatment Plants

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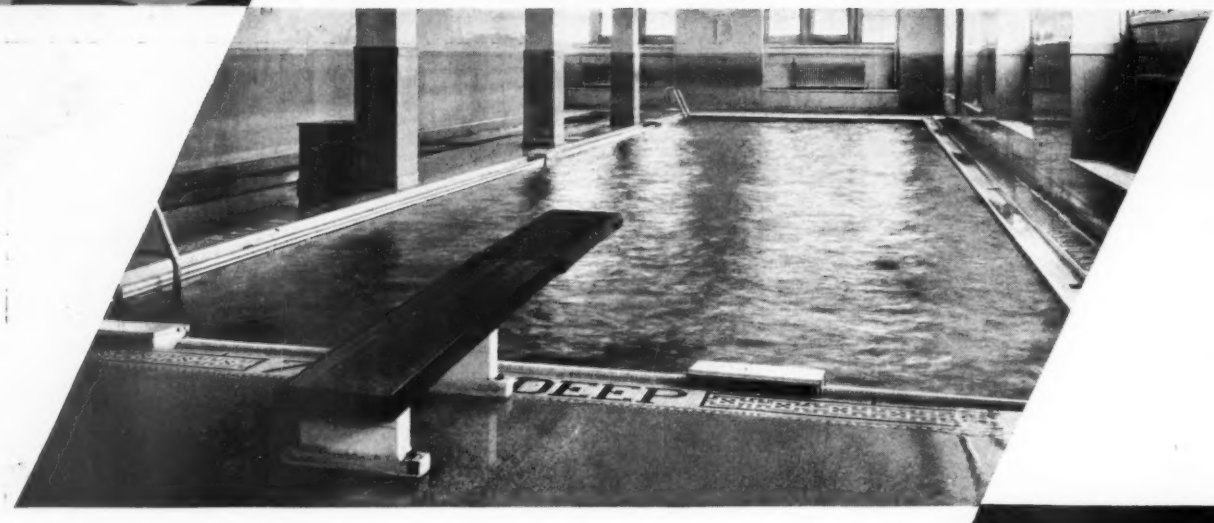

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